

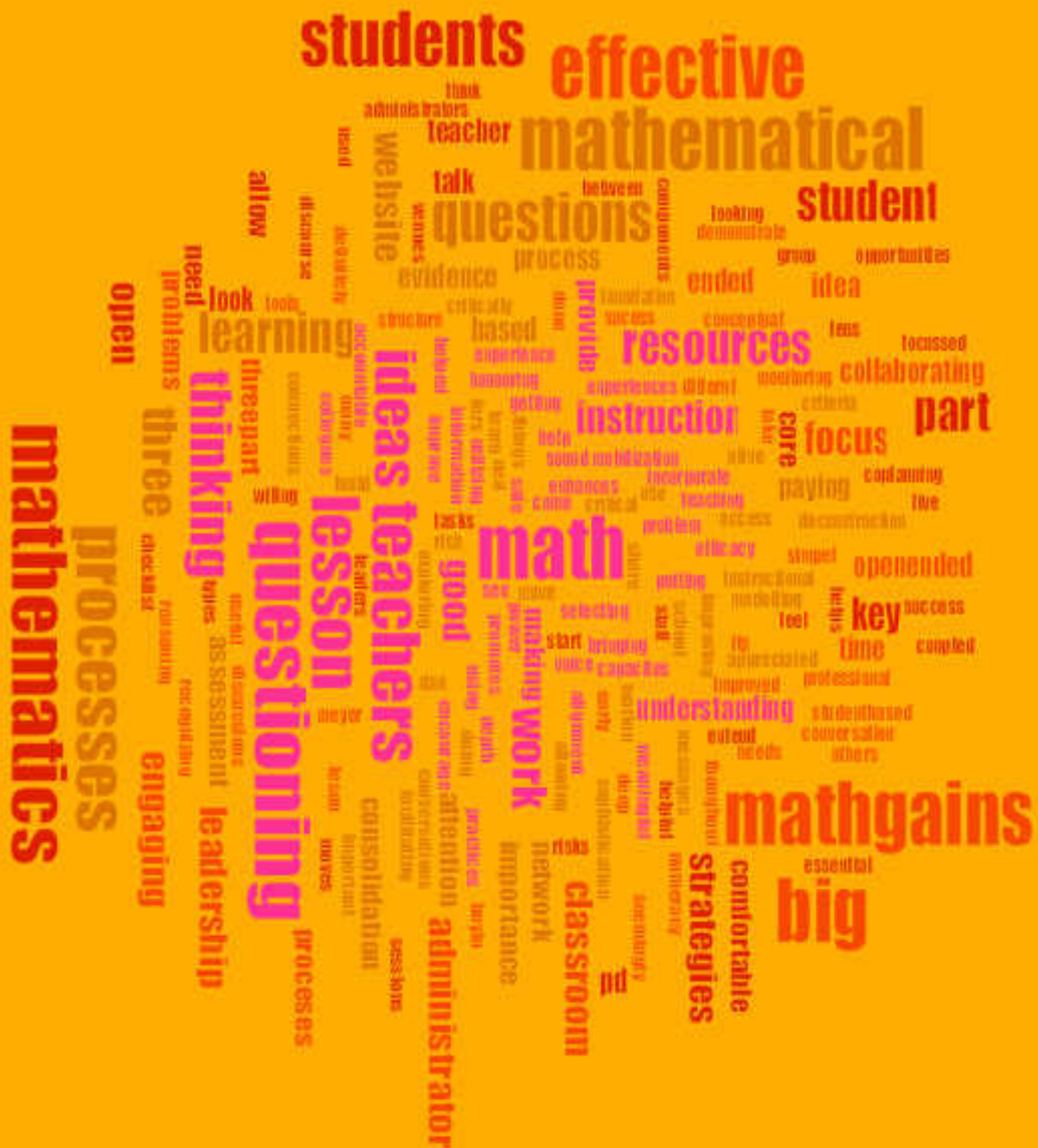


Professional Learning Mathematics Series for School and System Leaders

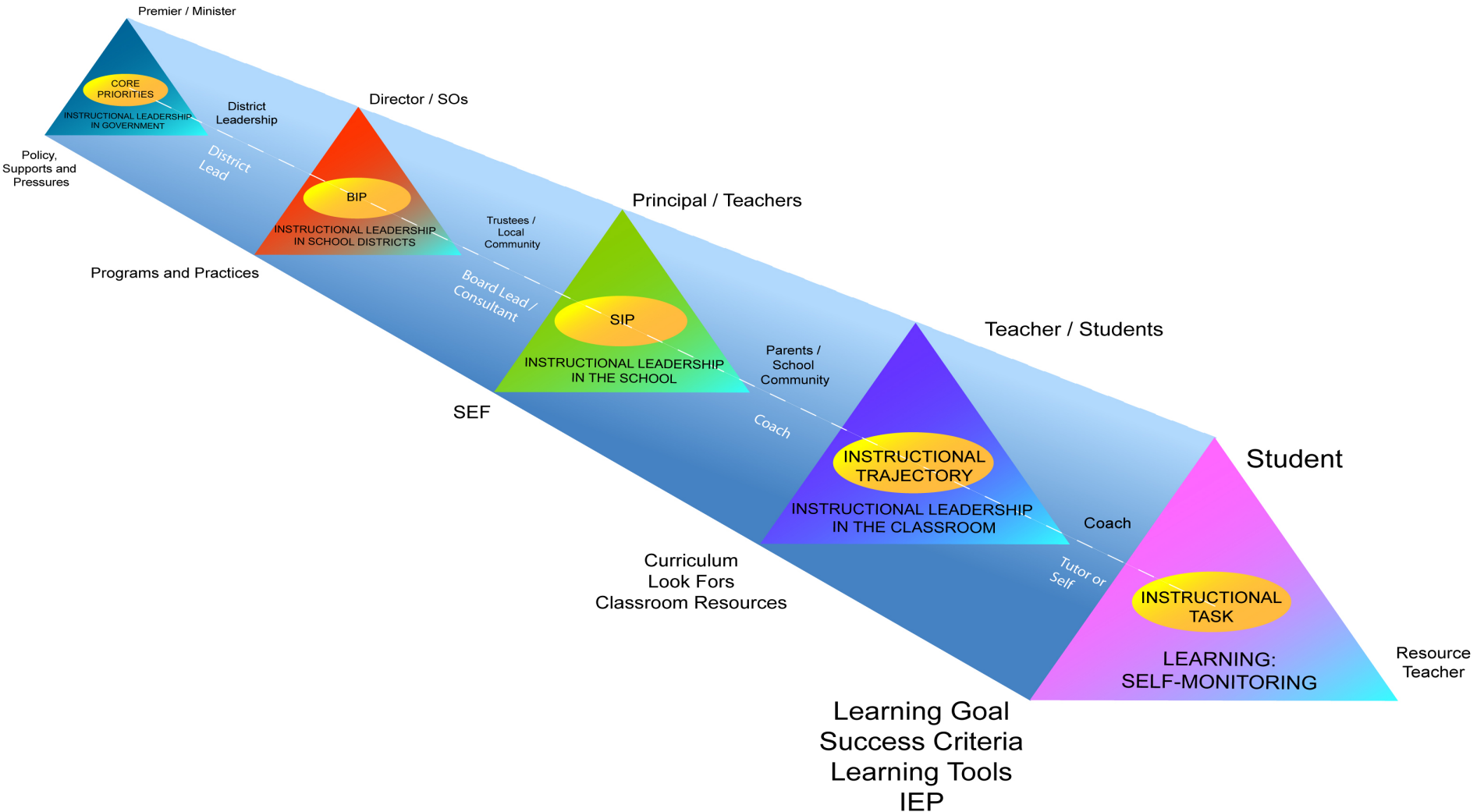
Day 2
Thunder Bay and Toronto

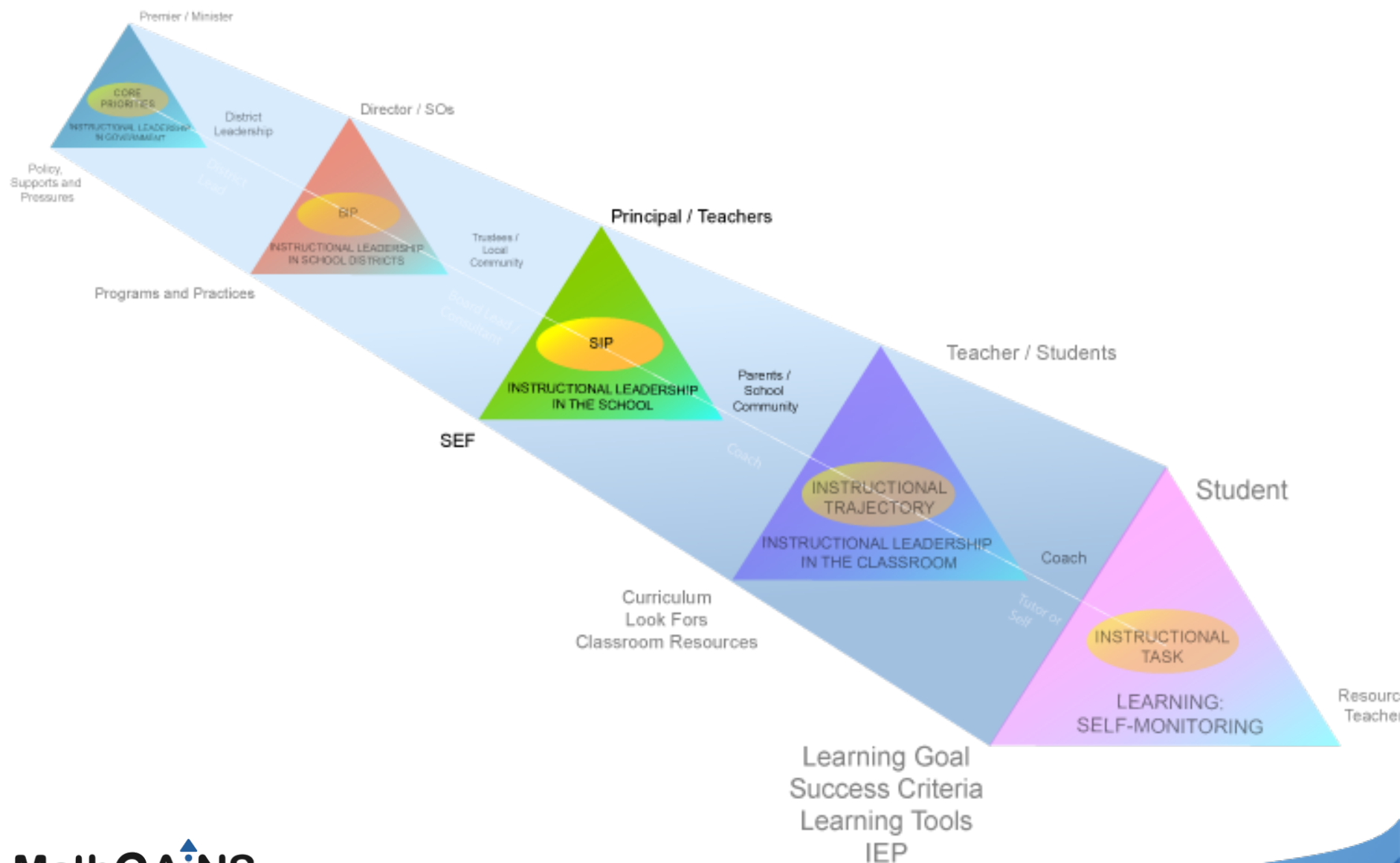
Wireless Internet

- Connect to CNAV004
- Password: catering



Instructional Core





Learning Goals

- Understand the importance of big ideas (key concepts) in mathematics and their connection across the grades.
- Examine whole school mathematics PLC from pre-planning through implementation and review and its effect on improved teaching and learning practices.

Follow Us on Twitter

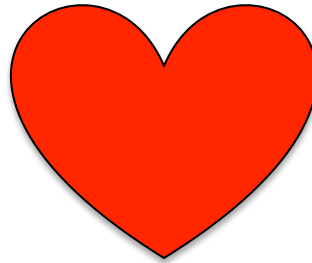
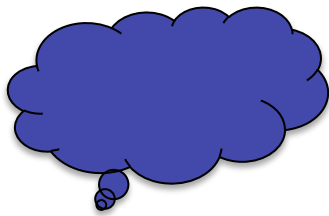
- Hashtag #PLMDayTwo

twitter



After Day One

- Webinar – March 20th with Doug and Jen
- Webcast – Leadership Resources
- Webcast – SCDSB Aligning Numeracy Goal to Instructional Core



After Day One

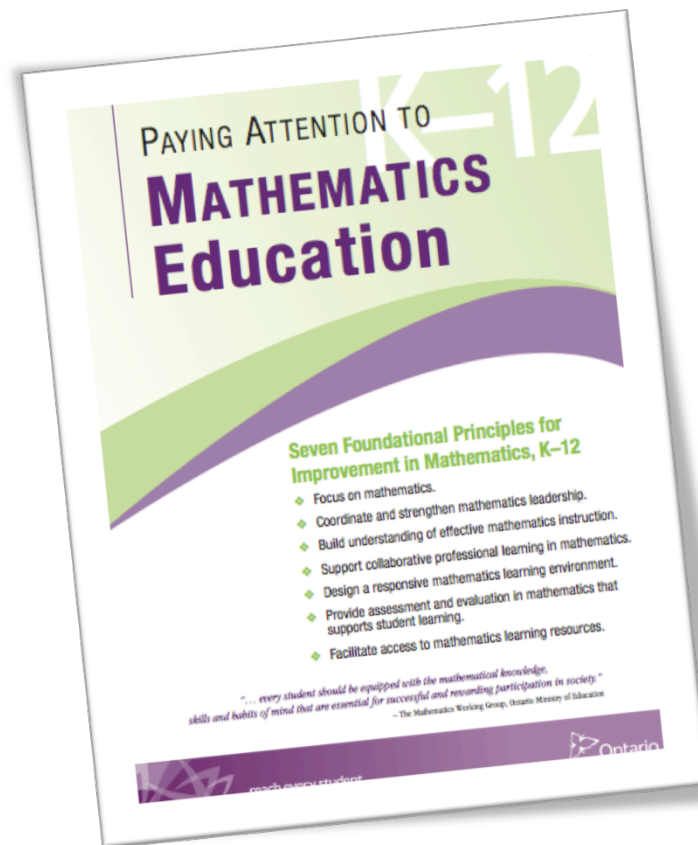
Choose a chart to visit.

Use sticky notes to place comments by

- a) Head – what did you think about?
- b) Heart – how did you feel?
- c) Hands – what did you do or will do about what you learned?

Paying Attention to Mathematics

- Focus on mathematics
- Build understanding of effective mathematics instruction.



Discussion Tool

Where are you on the continuum with your school?

A DISCUSSION TOOL FOR

PAYING ATTENTION TO MATHEMATICS EDUCATION, K–12

To be used in board and school planning, as a discussion tool, to assess implementation of each of the seven foundational principles:

- ❖ Focus on mathematics.
- ❖ Coordinate and strengthen mathematics leadership.
- ❖ Build understanding of effective mathematics instruction.
- ❖ Support collaborative professional learning in mathematics.
- ❖ Design a responsive mathematics learning environment.
- ❖ Provide assessment and evaluation in mathematics that supports student learning.
- ❖ Facilitate access to mathematics learning resources.

MATHEMATICS FOUNDATIONAL PRINCIPLE:

CRITERIA	Developing →	Building →	Consolidating →	Sustaining →	Innovating
Breadth	We are collecting information about this foundational principle.	We are implementing strategies related to this foundational principle in some schools and classrooms board-wide.	We are implementing strategies related to this foundational principle in many schools and classrooms board-wide.	We are re-examining the quality and effectiveness of the implementation of this foundational principle and reviewing new developments in the field.	We are extending our practice related to this foundational principle.
Depth	We are exploring the components related	We are building system knowledge and monitoring	We are monitoring the implementation and	We are evaluating the impact of implementation	We are generating new knowledge to enhance

Where are you on the continuum?

Moving Math Forward

- It's all about the thinking.
- Strong attention to Big Ideas
- Inclusion
- Look-fors
- Leading conversations
- Valuable resources

Minds On

- Kipper's Cookie Caper



Question

- If Kipper ate a lot less than half of the cookies, and Sadie definitely ate more than Kipper, how many cookies might have been in each bowl?

Where's the math?

- They are seeing many possible numbers of cookies to start in the bowl (but only one that really happened)
- They are thinking about what half means
- They are decomposing numbers
- They are gaining adding and subtracting practice
- They are learning the value of working backwards

Bottom line

- It should mostly be about figuring things out.
- A much lesser proportion of the time is about following sets of instructions.
- Practice can happen in figuring things out.
- Assessment of learning must also focus on thinking.

Discuss

- How much thinking are you seeing in the mathematics classrooms in your school?
- What fraction of the time?
- Are you comfortable with that?

Why change is needed

- What do we know? What do our data tell us?
- Are we satisfied with what we have learned about our students and their achievements in mathematics?
- If not, are we willing to make change in some way?

Lucy West

Role of the Principal



Why Change is Needed

- Why is identifying beliefs, purposes, and passions important for making substantive changes in a school?
- Why is shared leadership necessary in professional learning communities?
- Why are long-range outcomes and short-term results important in the change process?

Foundational Principles

❖ Foundational Principle

Build understanding of effective mathematics instruction.

Five teaching practices for improving the quality of discourse in mathematics classrooms:

(1) “talk moves” that engage students/facilitate discussion, (2) the art of questioning, (3) using student thinking to propel discussions, (4) setting up supportive environments and (5) Orchestrating the discourse

— Chapin, S. H., O'Connor, C., & Anderson, N. C. (2009). *Classroom discussions: Using math talk*

❖ Foundational Principle

Support collaborative professional learning in mathematics.

“We conceptualize teacher professional learning as embedded in the classroom context and constructed through experience and practice in sustained iterative cycles of goal setting/planning, practicing, and reflecting.”

— Bruce, C. D., Esmonde, I., Ross J., Dookie, L., & Beatty, R. (2010). The effects of sustained classroom-embedded teacher professional learning on teacher efficacy and related student achievement. *Teaching and Teacher Education*, 26, 1598–1608.

Professional Learning IQ

- Read and respond to questions.

What's your
**PROFESSIONAL
DEVELOPMENT** **IQ?**

Professional Learning IQ

1. All of them.
2. d. 60%
3. b. Raising the calibre of teachers and principals; school based decision making
4. c. Teachers observing each other in the classroom and providing feedback.

Professional Learning IQ

- 5. a. Content of the subject taught (57%)
 - b. 27%
 - c. 14%
 - d. 14%
- 6. c. A good principal!

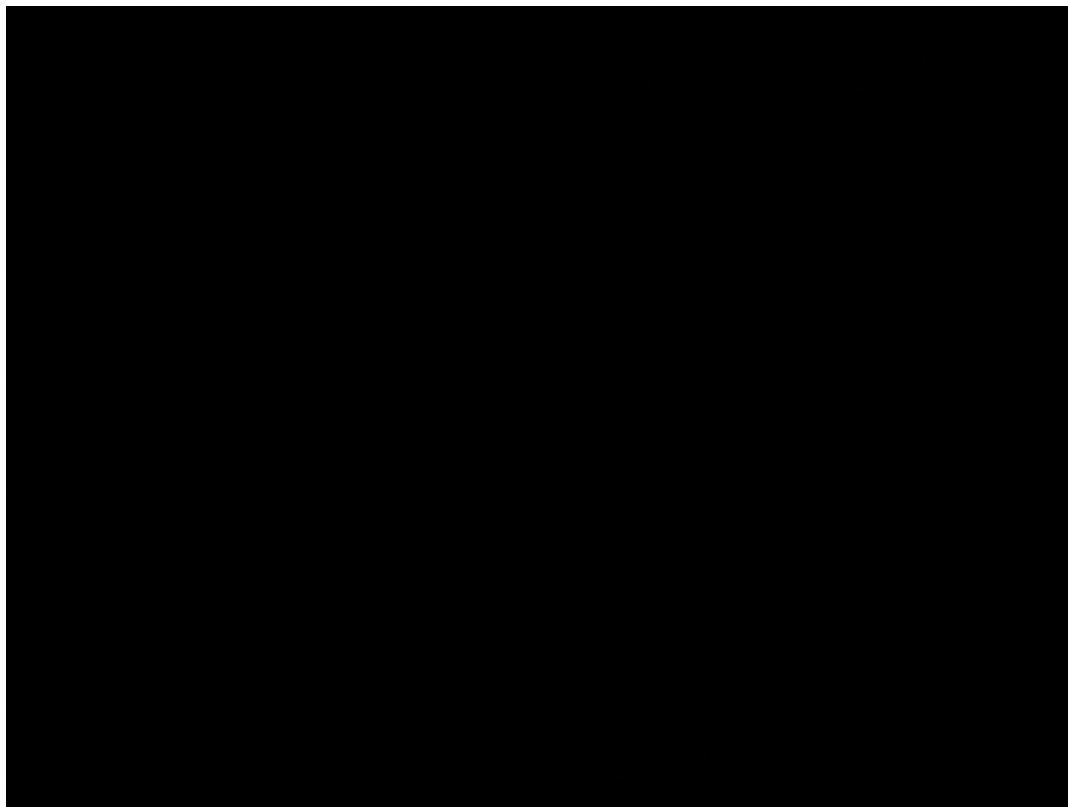
Professional Learning

- How do your perceptions compare to the information from the reports?
- What are the implications of the answers?

BELIEF: Every student learns when every educator engages in effective professional learning.

Lucy West

Learning Cultures



What is a PLC?

How is a professional learning cycle
the same or different than
a professional learning community?

A PROFESSIONAL LEARNING CYCLE

Plan

Two or more team meetings

1. **Examine data/evidence** to determine an area of need related to student achievement and/or engagement.
2. **Select a learning focus** (e.g., for a specific area of student need; select curriculum expectation, standard, or skill of expected student learning)
3. **Determine educator learning** (e.g., review current instruction, identify student need)
4. **Plan "with the end in mind"**
 - Decide what evidence will indicate if the plan is successful.
 - Develop evaluation task and schedule (e.g., data wall).
 - Design instruction using research-based, differentiated approach (DI).
 - Acquire required resources.

What is the current reality?

Two factors critical to effective job-embedded learning are:

- Shared tri-level (i.e., board, school, classroom) responsibility for leading, supporting and monitoring job-embedded professional learning
- Team leaders, knowledgeable in differentiated instruction, whose training, ongoing learning and support is facilitated by board and school leaders

Act

One or more team meetings

5. Implement evidence-based strategies and actions

- Implement instruction, adjusting as needed, based on ongoing assessment and feedback from students
- Engage in professional learning (e.g., co-teaching, peer observation, lesson study, coaching/mentoring) to build a collective understanding of the instructional approach
- Access professional learning resources (e.g., release time, class coverage, learning materials, subject-specific support and a DI-knowledgeable team leader)

Observe

One or more team meetings

6. Monitor—student learning and educator learning

- Share and examine evidence of student learning, including student feedback, record on tracking chart/data wall, devise next steps
- Share instructional practice, discuss instructional issues, find solutions for challenges, determine next steps for educator learning

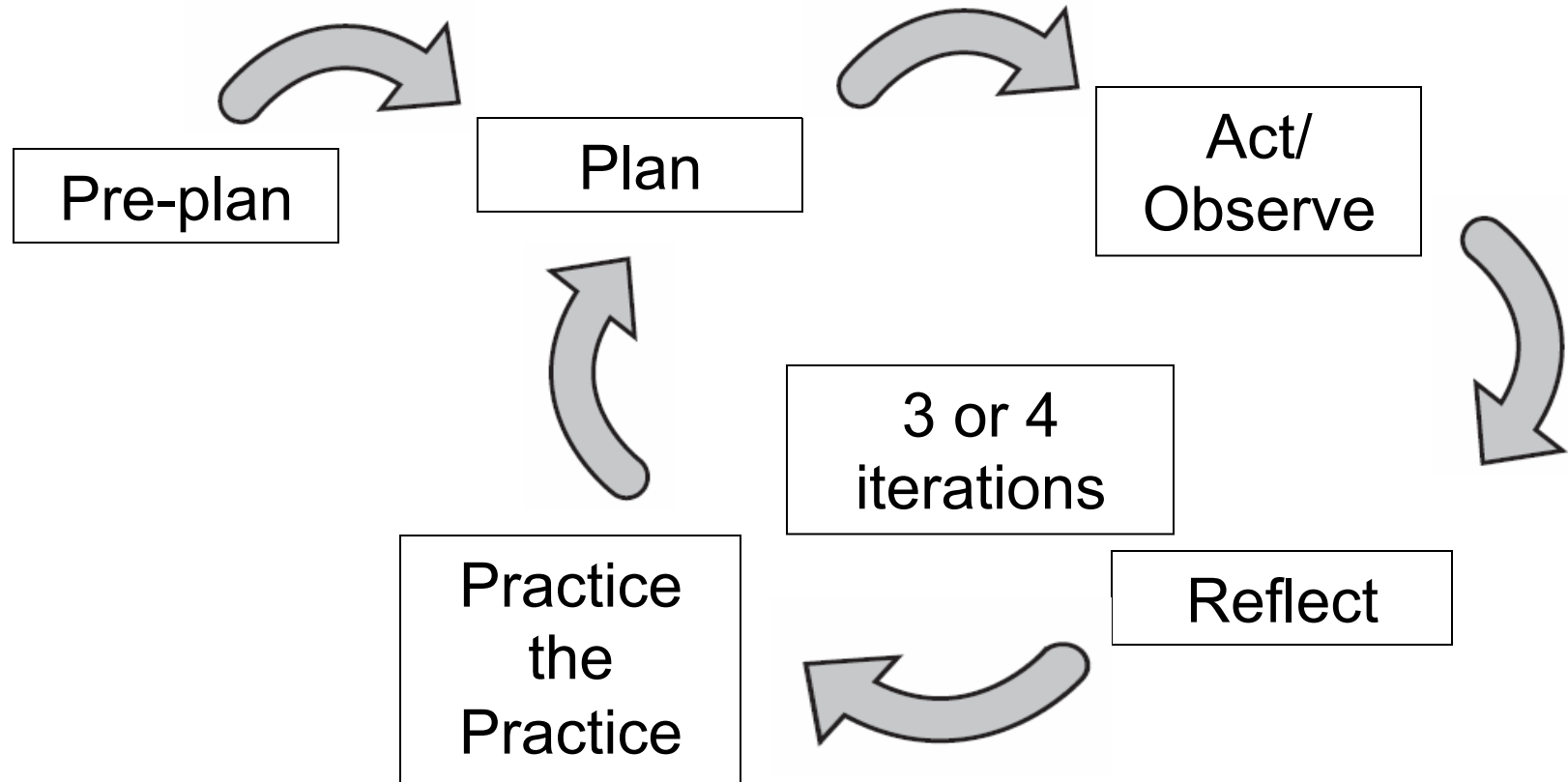
Reflect

Two or more team meetings

7. Examine, analyze and evaluate results:

- Co-assess/evaluate student work, share student feedback, display results
- Decide, based on evidence, the extent to which the area of student need has been addressed
- Reflect on educator learning, decide next steps

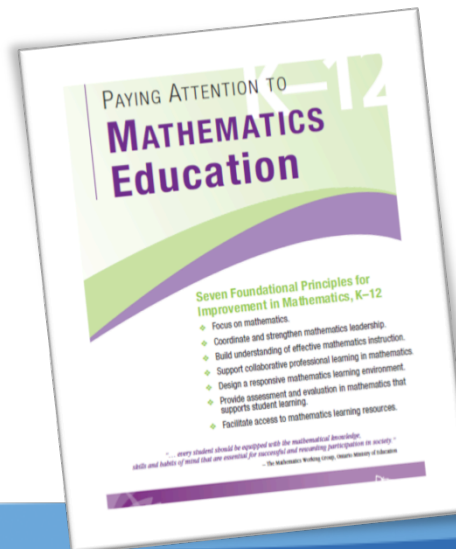
School Board Numeracy Professional Learning Cycle



Foundational Principles

Support collaborative professional learning in mathematics.

- a focus on students, student thinking and student demonstrations of understanding
- an integrated blend of learning inside and outside of classrooms with a commitment to collaborative inquiry
- an iterative, cyclical approach informed by monitoring and implementation, and knowledge dissemination





Big Idea

- Operations hold the same fundamental meanings no matter the domain to which they are applied.

Each operation – addition, subtraction, multiplication, and division – means more or less the same thing no matter what objects are being used.

Learning Goal

- Students recognize that you can apply the same calculation to solve very different problems involving $+$ and $-$ and use a variety of strategies to perform the calculation

Possible Task

Create **three** problems that seem really different for solving by calculating:

$$80-14$$

Tell why each problem makes sense and solve each one in a different way.

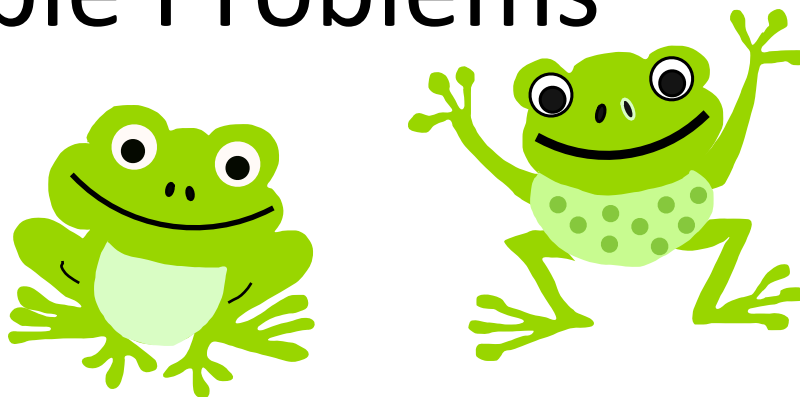
Consolidation

Consolidation Questions

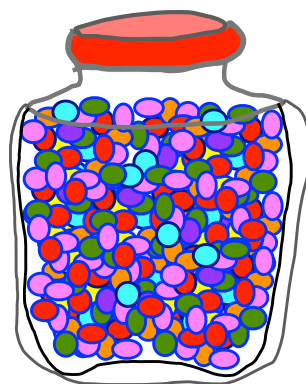
- What made your problems similar?
- Could they have been solved using a different operation?
- Tell me how.
- What made your problems different?
- What kinds of problems would you call subtraction?

Possible Problems

A frog jumped 80 times. His friend jumped only 14 times. How many more times did the frog jump than his friend?

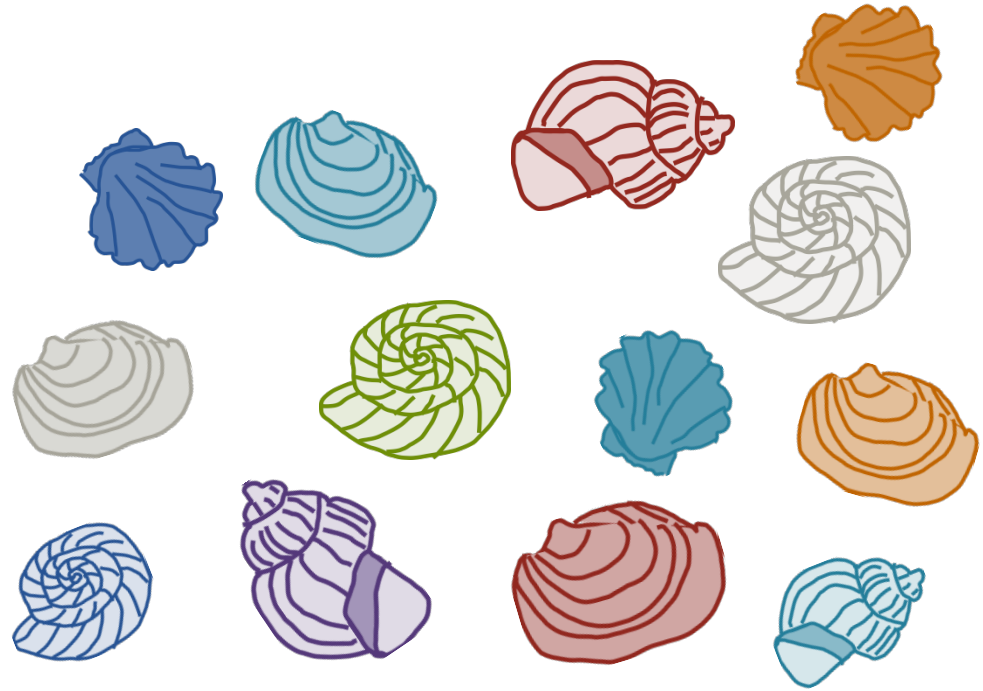


A jar of candies had 80 candies. Zach ate 14 of the candies. How many were left?



Possible Problems

You need to collect 80 shells at the beach. You only have 14 so far. How many more do you need?



Where's the math?

What are the look-fors?

- Student Samples
- Grade 2 and Grade 3

Create **three** problems that seem really different for solving by calculating:

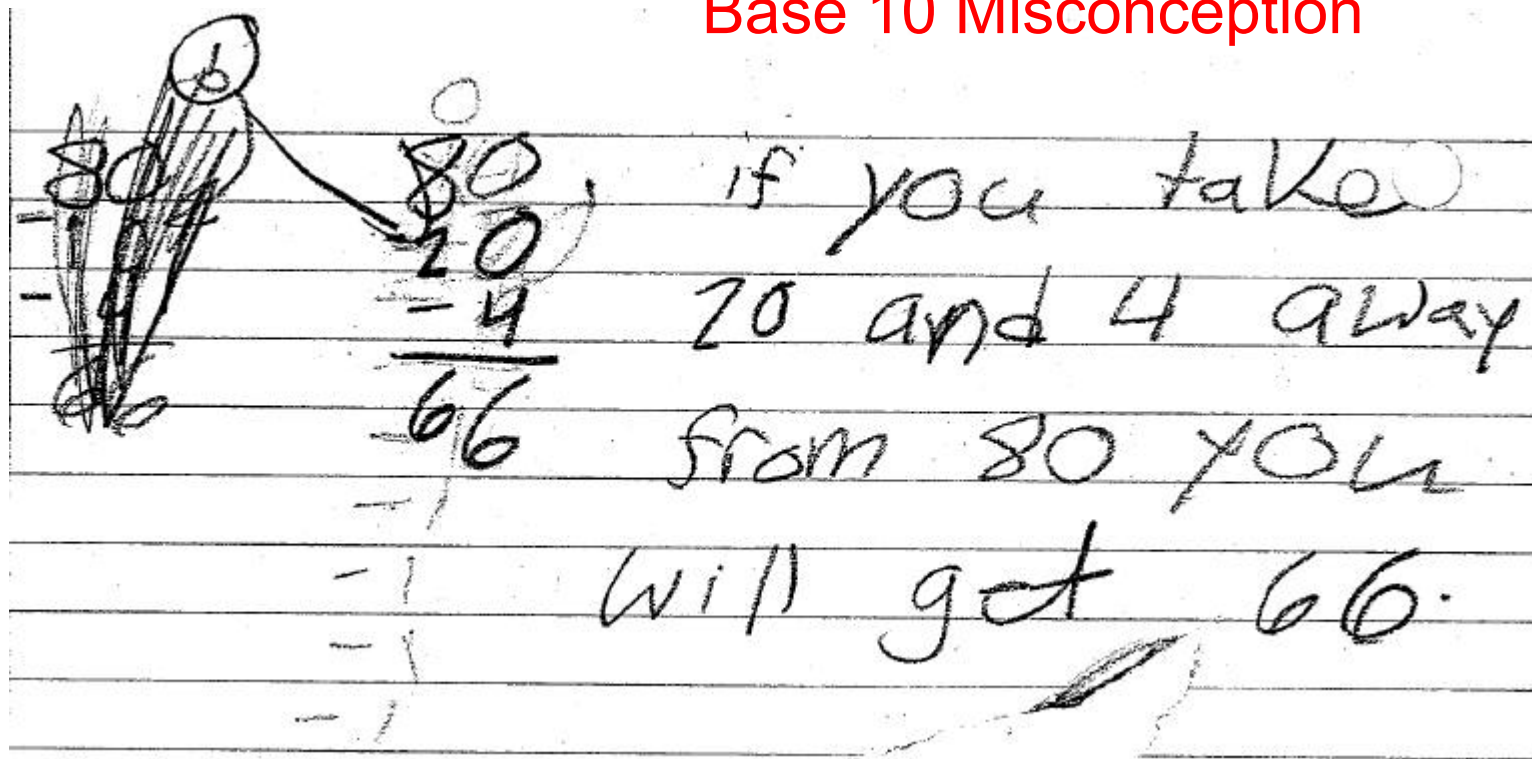
80-14

Tell why each problem makes sense and solve each one in a different way.

80 - 14

Gr. 2

Base 10 Misconception



The image shows a student's handwritten work on lined paper. On the left, there is a vertical subtraction problem: $\begin{array}{r} 80 \\ - 14 \\ \hline \end{array}$. The '8' and '0' are circled, and a line is drawn from the '0' to the '2' in the second problem. The second problem is $\begin{array}{r} 80 \\ - 20 \\ - 4 \\ \hline 66 \end{array}$. To the right of the problems, the student has written: "if you take 20 and 4 away from 80 you will get 66." This illustrates a common base 10 misconception where students subtract the tens and ones separately without borrowing.

80 - 14

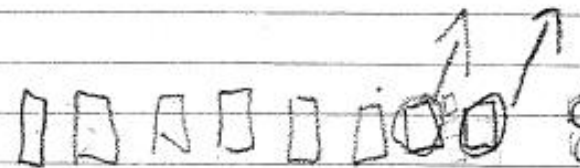
Gr. 3

Understands
Base 10

Adding the same
amount to both
numbers doesn't
change the difference

Adding up to
Subtract

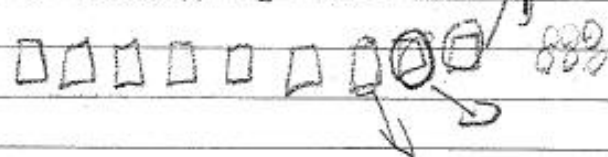
80 brownies - 14 = 66



2 90 - 24 = 66

80 + 10 =

90 brownies - 24 = 66



100 - 34 = 66

110 brownies - 44 = 66



3 80 - 14 = ?

80 - 14 = 66

14 + 20 = 34

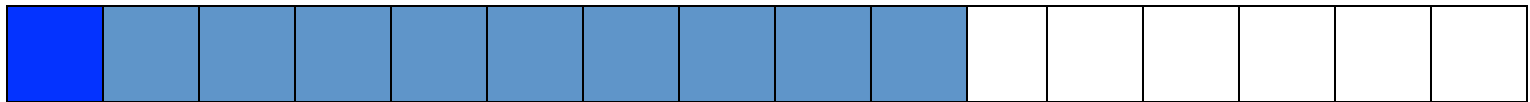
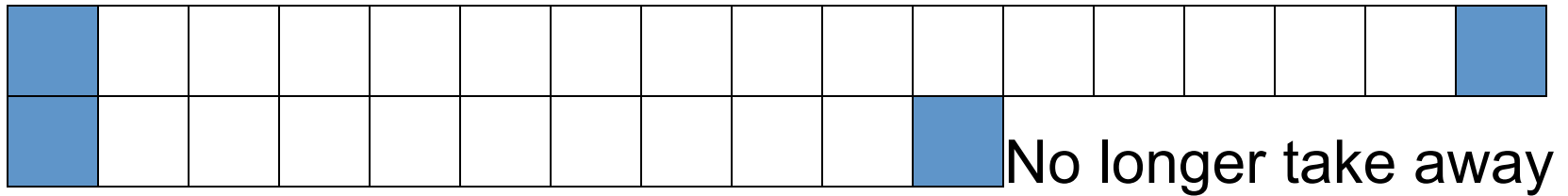
34 + 20 = 54

54 + 20 = 74

74 + 6 = 80

20 + 20 + 20 + 6

Why is $15 - 9 = 16 - 10$?



80 - 14

Gr. 3

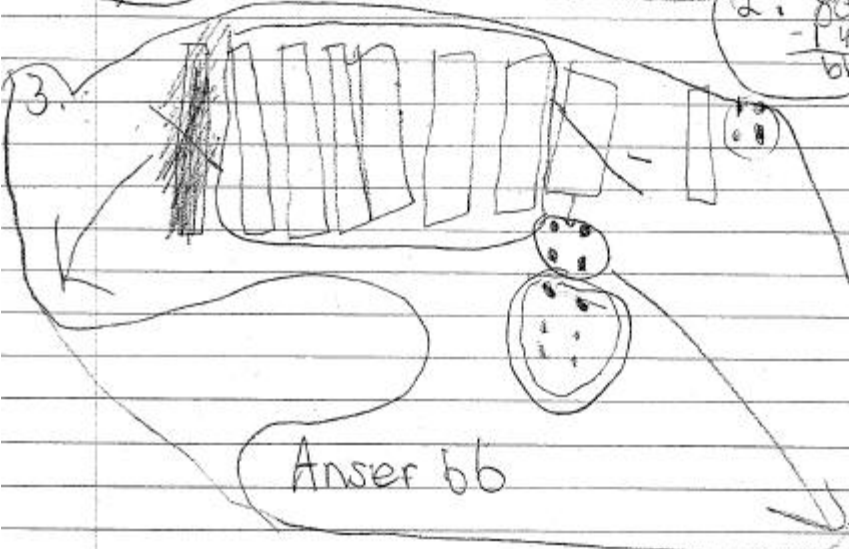
Problem Posing
Take-Away

Base 10

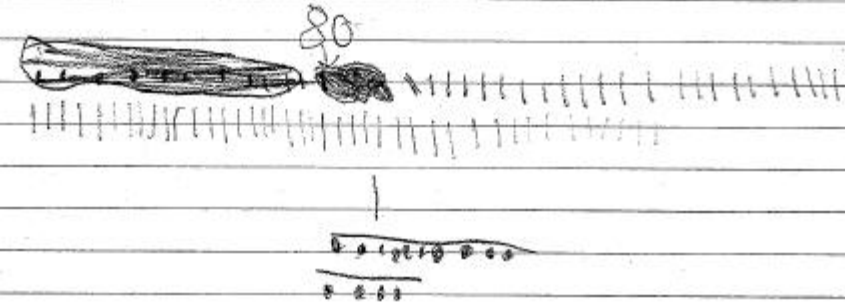
Comparing
to Subtract

1. you have 80 dollars you spend 14 dollars
how many dollars do you have left.
you have 66 dollars left.

2.
$$\begin{array}{r} 80 \\ - 14 \\ \hline 66 \end{array}$$

3.  See back

Answer 66

1. 

There are 66 more tally marks.

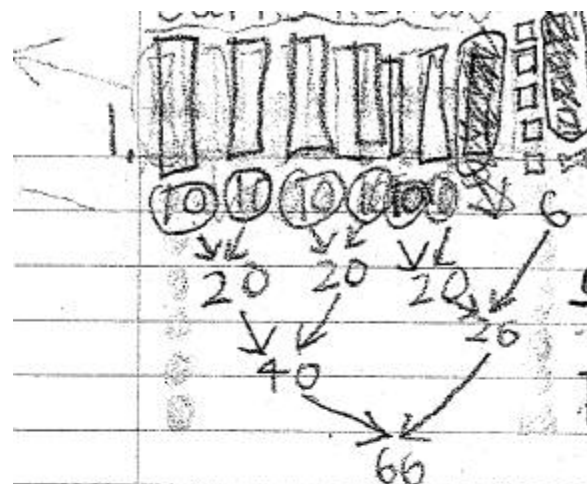
80 - 14

Gr. 3

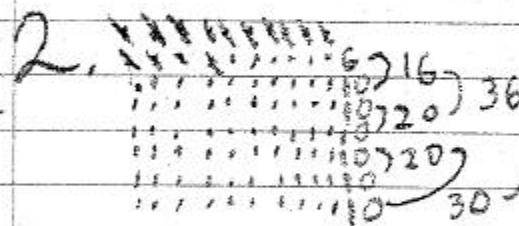
Base 10

Take-Away

Count up by
Guessing



First I drew 7 tens. Then I drew 10 ones. After I circled 4 ones and 1 ten and scribbled them out. After that I drew arrows adding the tens together. Then I added the ones on. Finally I finished adding them together I got 66 answer



First I drew 80 dots. Then I crossed out 14. After I added them up and got the total 66.

$$\begin{array}{r} 14 - 14 = 14 \\ + 70 \\ \hline 84 \end{array}$$

First I added $14 + 70$ it equaled 84 (too high). Then I added $14 + 60$ it was 74 (too short). After I added $14 + 65$ it was 79 (too short). Finally I added $14 + 66$ it equaled 80. So the answer is 66. $14 + \square = 66$

Big Idea

- Operations hold the same fundamental meanings no matter the domain to which they are applied.

Each operation – addition, subtraction, multiplication, and division – means more or less the same thing no matter what objects are being used.

Responding to Student Work

- Big Ideas
- Learning Goals
- Success Criteria
- Look Fors

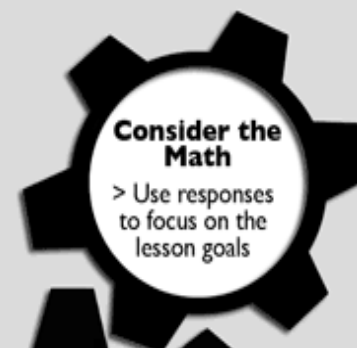
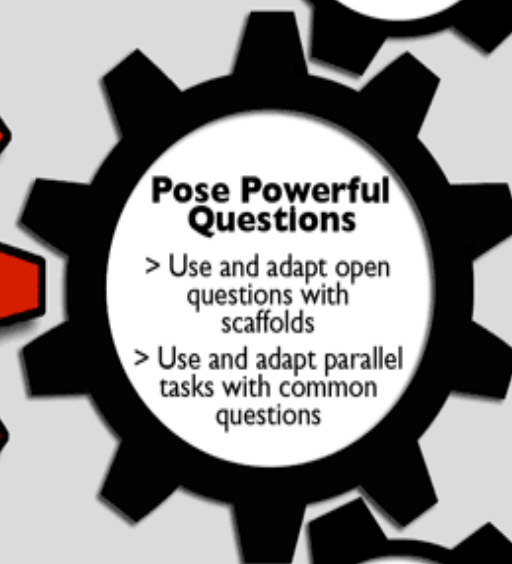
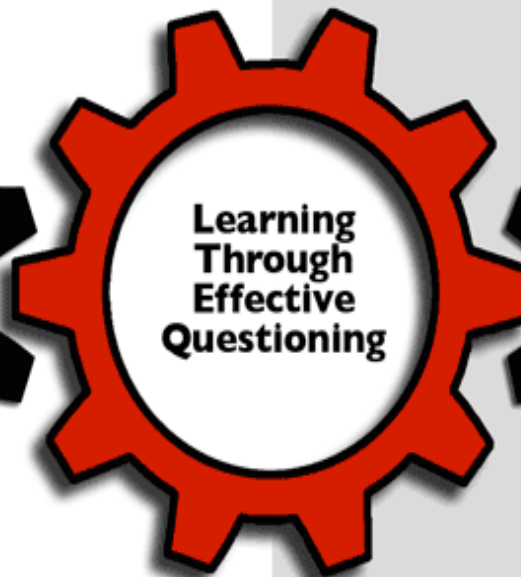
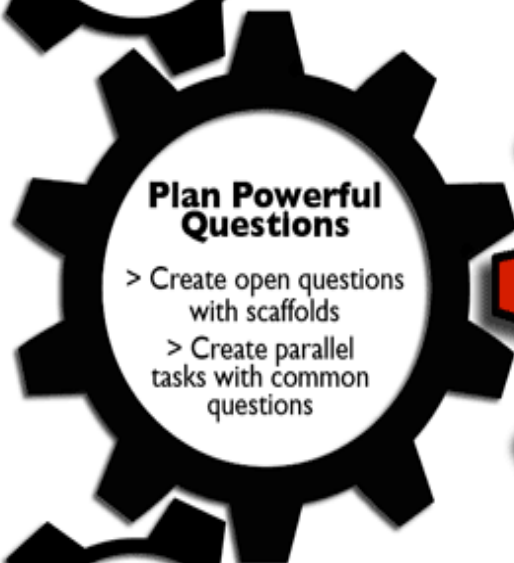
Marian Small

Responding to a Range of Students





OUTSIDE THE CLASSROOM



INSIDE THE CLASSROOM



Success Criteria

Recount Writing

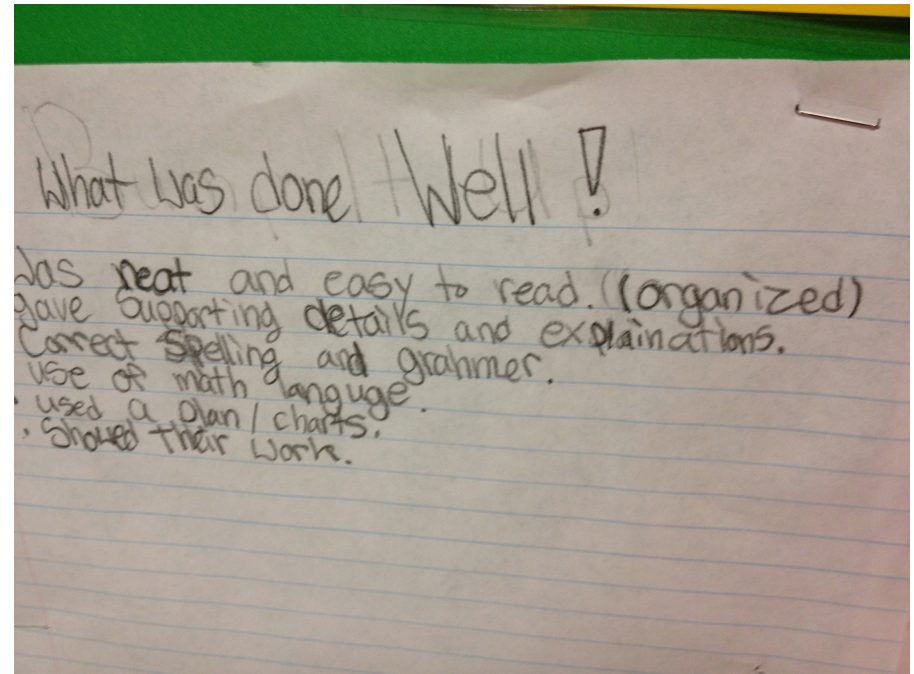
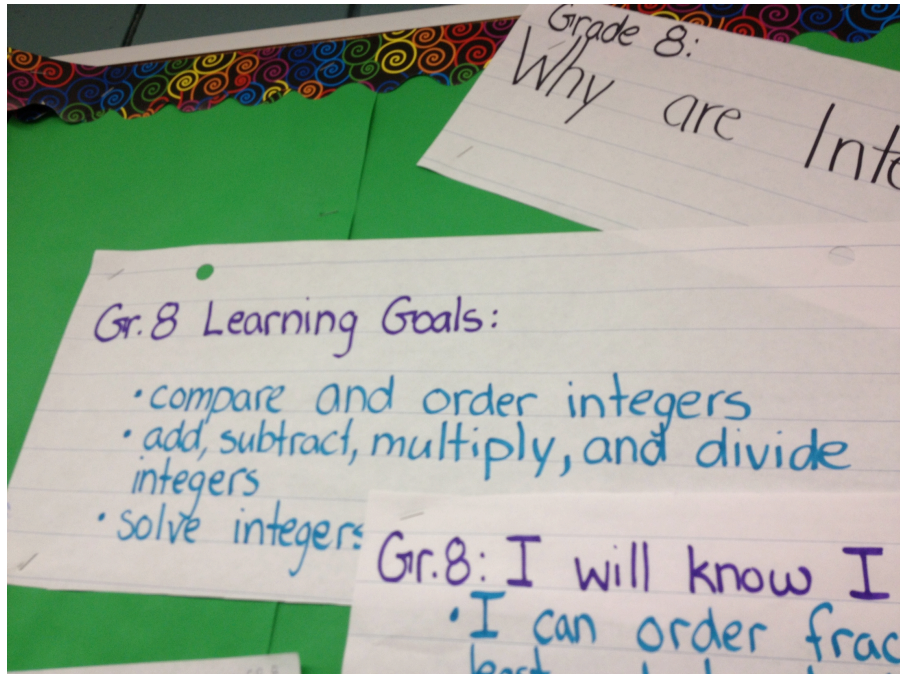
I will be able to . . .

- write a recount story about myself
- write about an event in chronological order
- use past-tense effectively

Success will look like . . .

- use of transition words (first, then, after, before, next, finally)
- chronological order
- use of vocab that is past tense
- use descriptive and vivid language
- use of specific characters, places, time

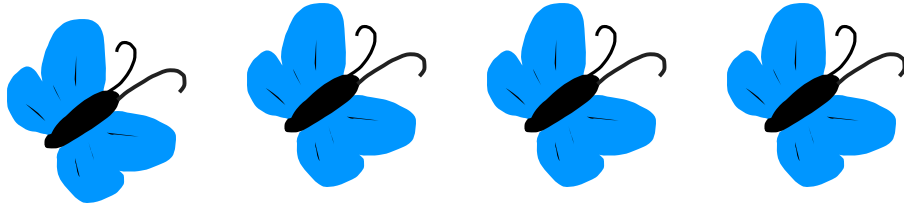
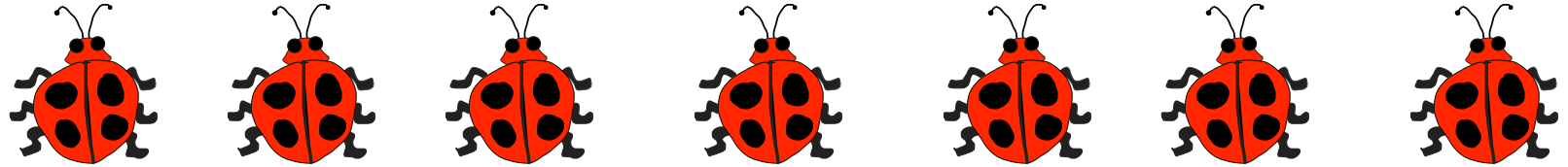
Success Criteria



Formative Assessment



Kindergarten



What does $7 - 4$ tell you about the bugs?

Kindergarten Early Subtraction

Logan

Marlee

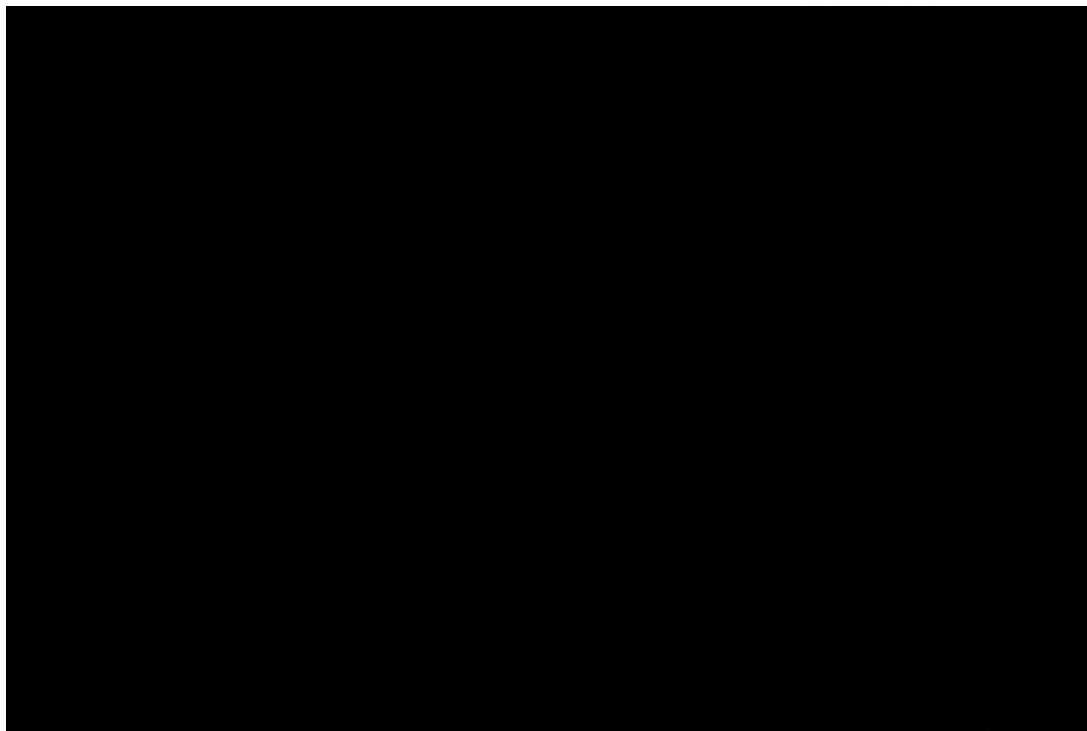
Ben

Ben 2

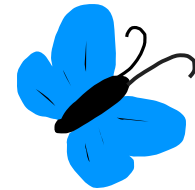
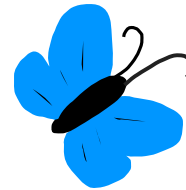
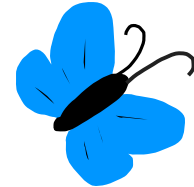
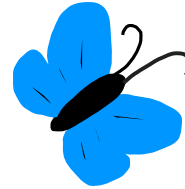
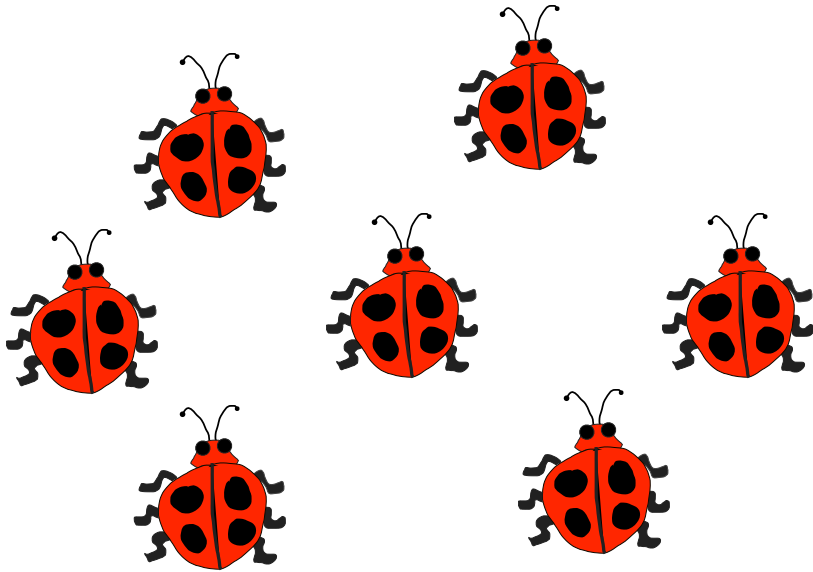
Success Criteria (Kindergarten)

- Student recognizes that $7 - 4$ tells how many more bugs than butterflies.
- And/or thinks of $7 - 4$ as how many more butterflies to match the ladybugs OR how many ladybugs would be left if 4 of them went away.

Debrief – Kindergarten



Grade 1



What does $7 - 4$ tell you about the bugs?

Grade 4, 5, 6

Create three problems that seem really different that you would solve by subtracting one of these sets of numbers.

$$80 - 14$$

Or

$$5.2 - 1.48$$

Tell why each problem makes sense and solve each one in a different way.

Grade 7, 8

Sometimes we use subtraction to compare how much more one amount is than another.

Other times we use subtraction to tell how much is left.

Other times we use subtraction to tell how much more we need.

Show how you would solve this subtraction question in each of those ways:

$$-8 - (-4)$$

Or

$$\frac{2}{3} - \frac{1}{2}$$

Grade 9 Applied and Academic

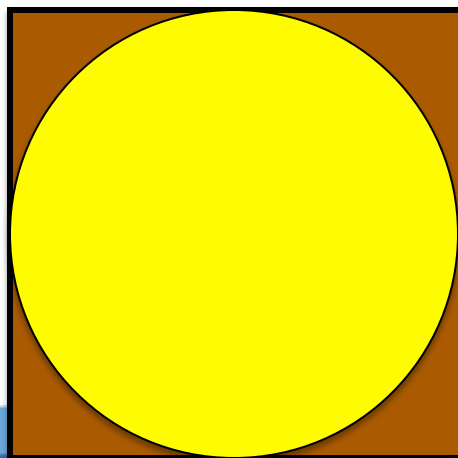
Sometimes we use subtraction to compare how much more one amount is than another.

Other times we use subtraction to tell how much is left.

Other times we use subtraction to tell how much more we need.

Show how you would solve this subtraction question in each of those ways:

Find the area of the shaded region.



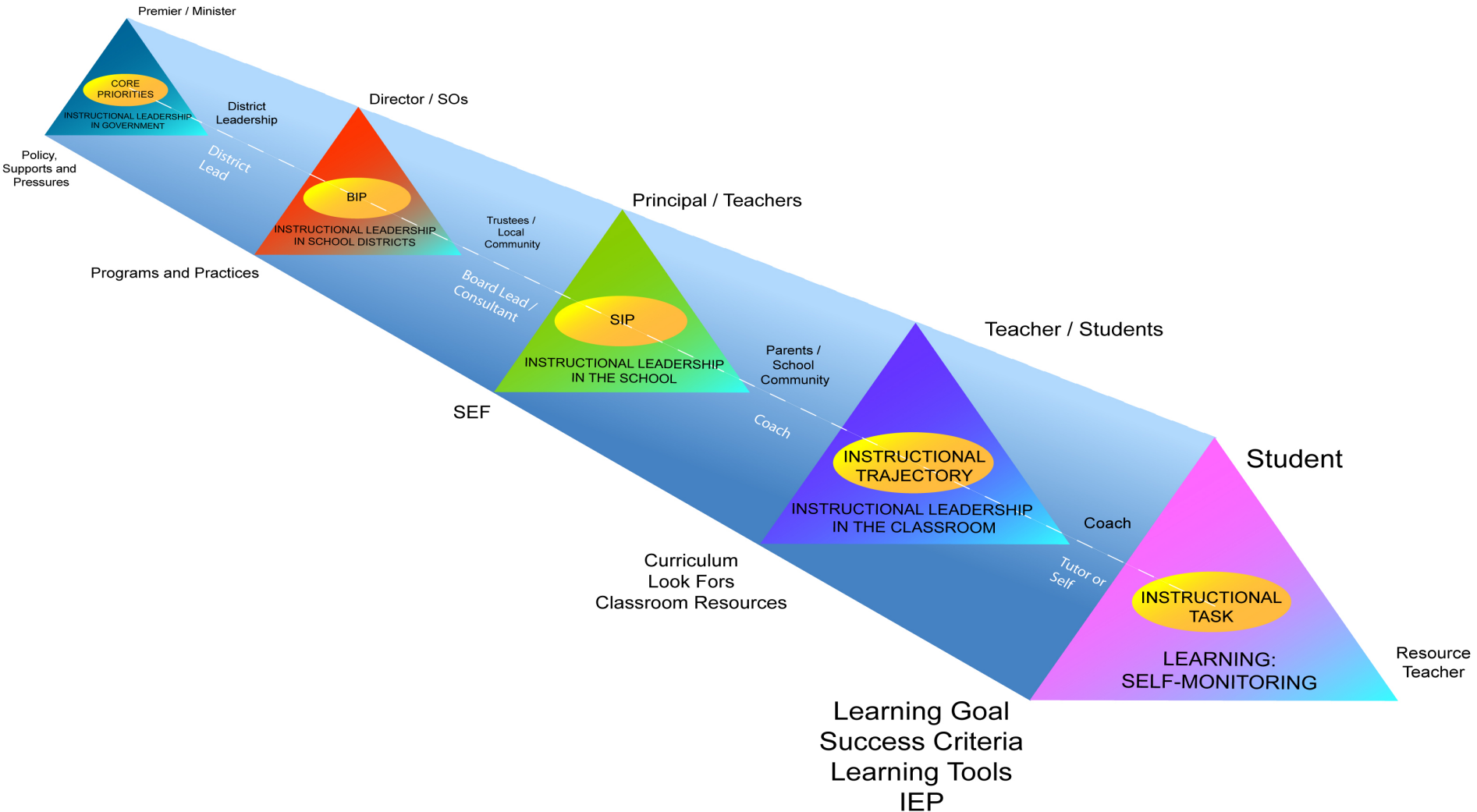
Grade 9, 10, 11

Create **three** problems that seem really different that you would solve by subtracting these two polynomials:

$$(4x - 2) - (3x - 2)$$

Tell why each problem makes sense and solve each one in a different way.

Instructional Core



Lucy West

Descriptive Feedback



Across the Grades

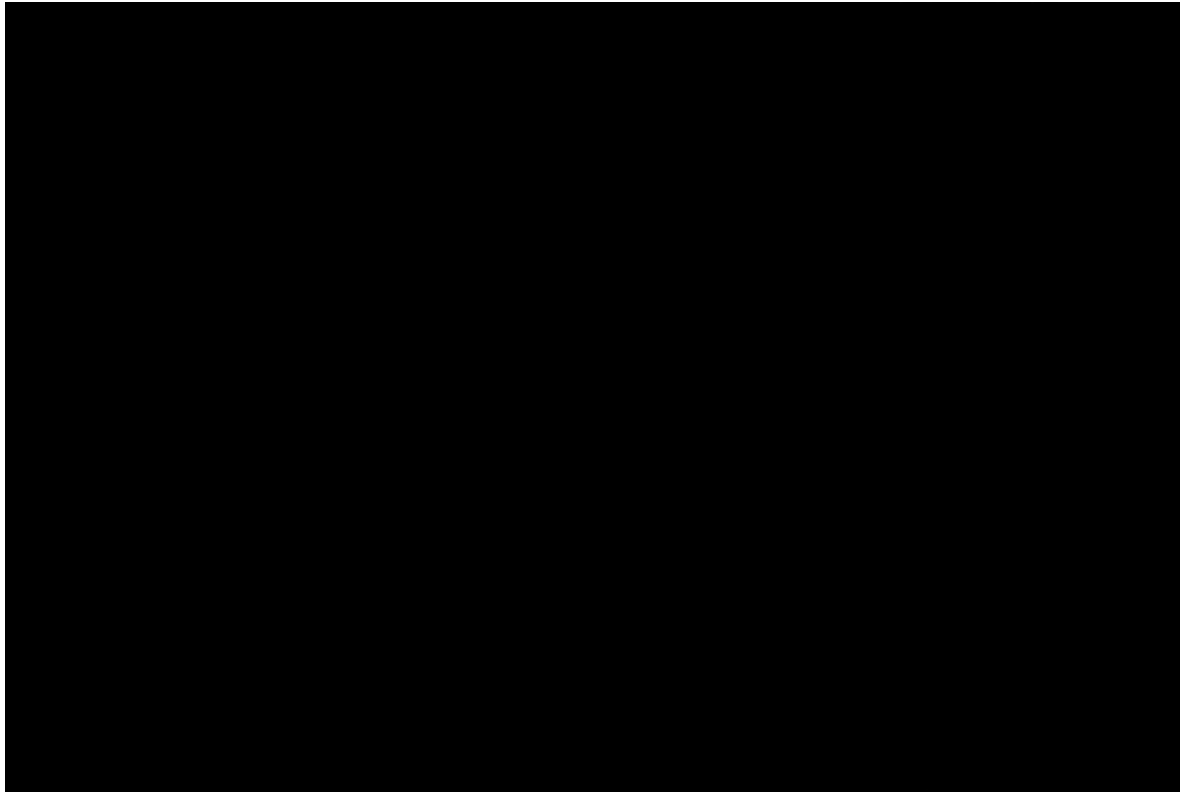
- Choose a grade group – Grade 4-6, Grade 7-8 or Grade 9-10
- Look at the student samples.
- Build success criteria.
- How would you respond to the student work?
- Principal role – what are the look fors?

Questions?

Grade 5



Grade 5





Across the Grades

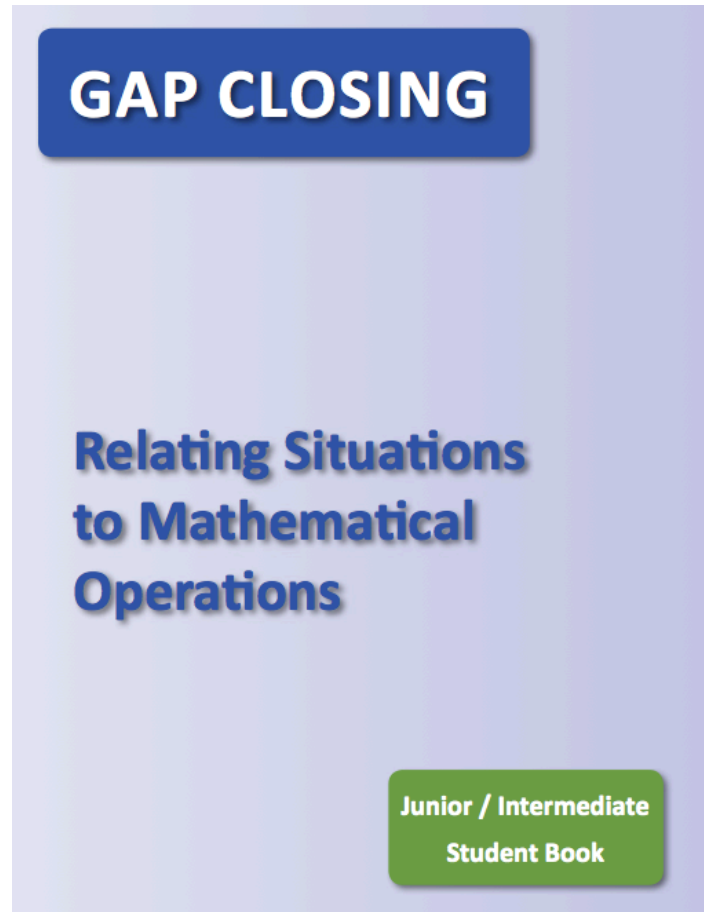
ACROSS THE GRADES – SUBTRACTION PROBLEM K-12 PARALLEL TASKS



Big Idea: Operations hold the same fundamental meanings no matter the domain to which they are applied.
(Each operation – addition, subtraction, multiplication, and division – means more or less the same thing no matter what objects are being used.)

GRADE	Curriculum Expectation	Possible Problem	Samples of Student Work	Consolidation Questions	Success Criteria
Kindergarten – Grade 1	<ul style="list-style-type: none"> - investigate addition and subtraction in everyday activities through the use of manipulatives, and visual models or oral exploration - Solve a variety of problems involving the addition and subtraction of whole numbers to 20, using concrete materials and drawings 	<p>Kindergarten</p>  <p>What does $7 - 4$ tell you about the bugs?</p> <p>Grade 1</p>  <p>What does $7 - 4$ tell you about the</p>	<p>Video samples can be viewed at http://plm2012.wikispaces.com/</p>	<ul style="list-style-type: none"> - What does the 7 tell you about the picture? What does the 4 tell? - Why did you think [whatever they say] shows $7 - 4$? - If you say that $7 - 4$ tells how many more ladybugs than butterflies, why is it helpful to see all 7 ladybugs and all 4 butterflies? - If $7 - 4$ told how many ladybugs would be left if 4 left, would you need to see both 7 and 4 bugs? 	<ul style="list-style-type: none"> - Student recognized that $7 - 4$ tells how many more bugs than butterflies - Student thinks of $7 - 4$ as how many more butterflies to match the ladybugs and how many ladybugs would be left if 4 of them went away - Student recognizes why you need different models for different types of subtraction

Gap Closing J/I



Monitoring

- Leading Conversations
- Planning Framework
- Data Collection Spreadsheet
- 6 Student Samples (Markers) Discussion

Build understanding of effective mathematics instruction - p 6.

Five teaching practices for improving the quality of discourse in mathematics classrooms:

(1) “talk moves” that engage students/facilitate discussion, (2) the art of questioning, (3) using student thinking to propel discussions, (4) setting up supportive environments and (5) Orchestrating the discourse

– Chapin, S. H., O’Connor, C., & Anderson, N. C. (2009). *Classroom discussions: Using math talk to help students learn, Grades K–6 (2nd ed.)*. Sausalito, CA: Math Solutions.



MathGA:INS →



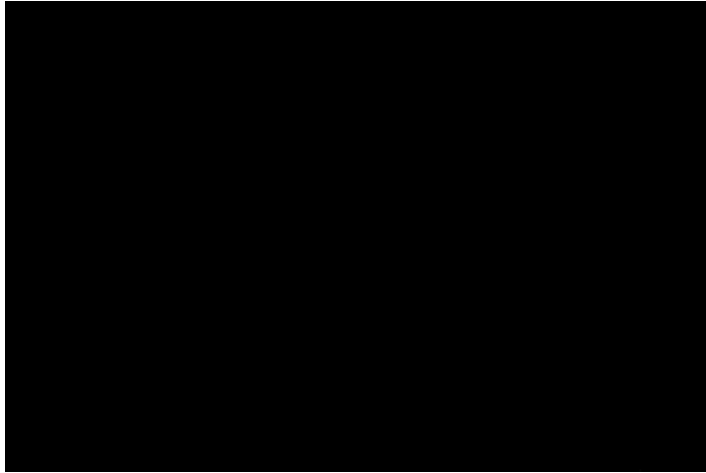
Leading Conversations

Leader of the past ... knew how to tell

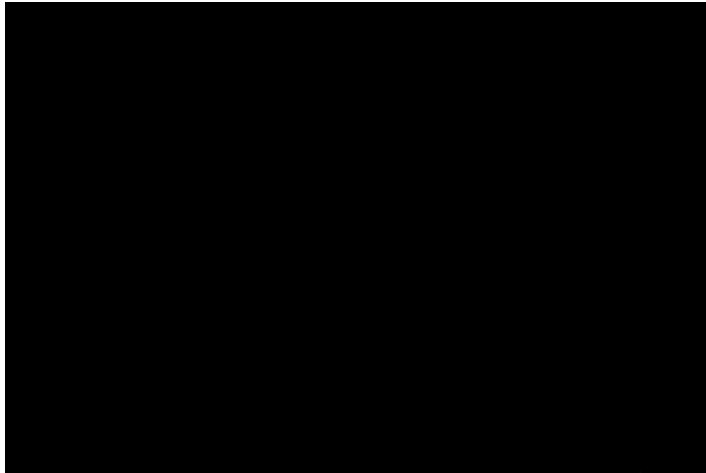
Leader of the future ... know how to ask

Leaders should be prepared to ask the right questions, facilitate the dialogue, and help build the shared knowledge.

Debriefing



Matt



Intermediate
Team

PLC Division/Grade Group PLANNING FRAMEWORK

PLC Group: _____

Process	Details	Notes
Time Line	Diagnostic Date: _____ PLC Audit Dates: _____ Summative Task Date: _____	Predictive data should be entered in database before Diagnostic task data. Dates may change.
Data Analysis Needs Assessment	<ul style="list-style-type: none"> What does our evidence of student achievement tell us? EQAO, Item Analysis, PRIME, DRA, Board data, Class data How do these needs connect to our school goals? 	Connected to our whole school data work when determining school goals.
Build clusters of expectations.	<ul style="list-style-type: none"> Which expectations from curriculum documents can be clustered to address student learning? How are these expectations related? 	
Big Ideas	<ul style="list-style-type: none"> What are the "Big Ideas" – the connected foundational elements? Consider cross-strand or cross-curricular key ideas. 	
Diagnostic Task	<ul style="list-style-type: none"> Design a common diagnostic assessment task that will measure each student's current thinking. Create a diagnostic rubric/assessment tool that allows comparison to summative. Select specific "marker" students to track growth across block (see note) Complete class data spreadsheet. 	Predict where students are currently and where they should be at the end of the cycle. After diagnostic select 6 "markers" - students whose work is representative of the Low, Medium and High group. Data will track markers throughout block.
Summative Task	<ul style="list-style-type: none"> Develop a summative task that uncovers expectations of what students were to know and be able to do over the learning time. Develop an assessment tool. 	Summative tasks: <ul style="list-style-type: none"> require higher-order and critical thinking skills "uncover" all big ideas.
Plan a four to eight week learning block.	<ul style="list-style-type: none"> How and what will we teach to uncover the big ideas – What are the Learning Goals? What Success Criteria, anchor charts, models can be used/posted? How do we use audit tasks and track "markers"? What "bump it up" strategies can we use to support learning? How do we use descriptive feedback to improve student work? -See markers 	<ul style="list-style-type: none"> Co-construct success criteria and anchor charts Post learning goals, success criteria and anchor charts for student consideration. Use SC in descriptive feedback.
PLC Audit Points	<ul style="list-style-type: none"> Plan after key chunks of learning and score in spreadsheet. How do audit points change next lessons? Reflect on big ideas. 	
Summative Task Assessment & Conferencing	<ul style="list-style-type: none"> Bring student work to share/moderate. 6 pieces L, M, H are analyzed in PLC Complete class data spreadsheets and highlight growth. Discuss use and effect of descriptive feedback. 	Analyze assessment data: <ul style="list-style-type: none"> Class assessment profile Compare predicted results Highlight examples of change in student work.
Next Steps	<ul style="list-style-type: none"> Principal collects data. Collates by class, grade, division, and school. 	Be prepared to share key findings in whole school meetings.

Planning Framework

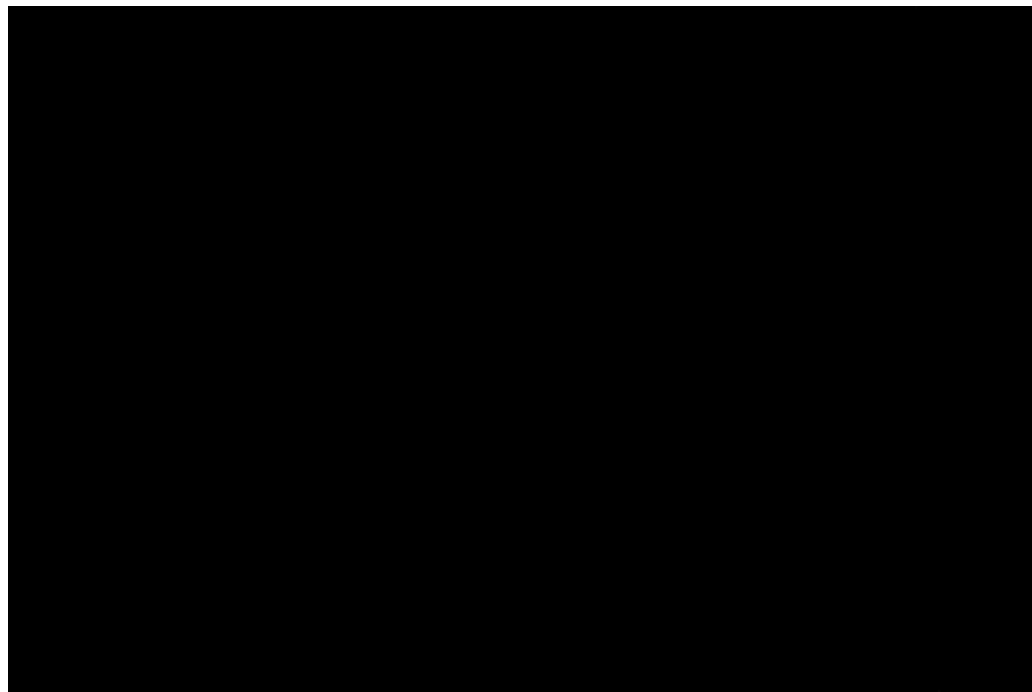
Data Collection

	B	C	D	E	F	G	H	I	J
			Learning Cycle Assessment						
	1E		Prediction	Diagnostic	Summative		Audit 1	Audit 2	Audit 3
1	Alex		2.5						
2	Andrew		1.5						
3	AnnaRose		3.7						
4	Carson		3.7						
5	Cayden		2						
6	Connor		4						
7	Holly		3						
8	Jack		3.5						
9	Jaxon		4.5						
10	Katie		2						
11	Katie		3.7						
12	Kate		3.5						
13	Kennedy		2.7						
14	Lucas		2.7						
15	Madison		4						
16	Matthew		3.5						
17	Rhea		4.7						
18	Skyler		3.5						
19	Taylor		3						

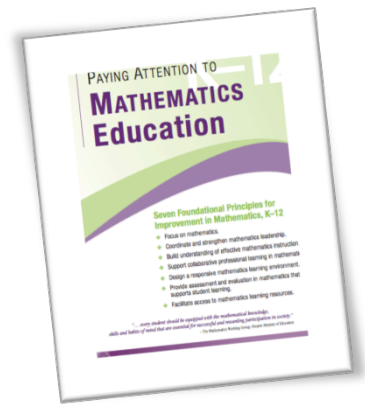
Administrator Actions to Support Effective Mathematics Instruction

Action	Look Fors and Questions
Math PLC	
Leading Conversations	
Data Collection	
Formative Assessment	

Moving Across the Network BIP



One School's Data Growth



❖ Foundational Principle

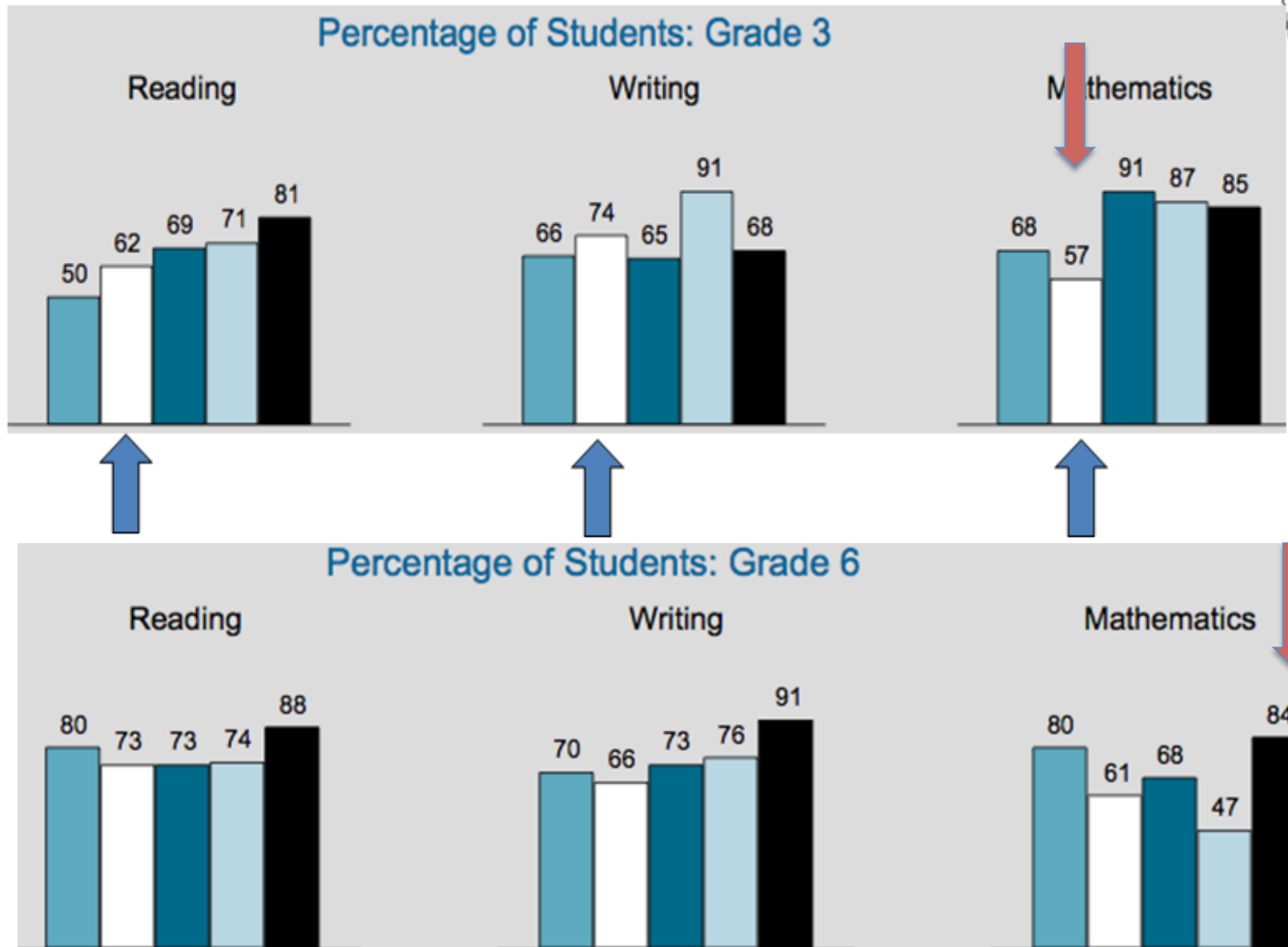
Focus on mathematics.

- Emphasis for our initiatives was connected to the overall improvement on numeracy, literacy and technology.
- Our achievement in EQAO has been noteworthy and has validated the consistency in focus and support.

One School's Data Growth

❖ Foundational Principle

Focus on mathematics.



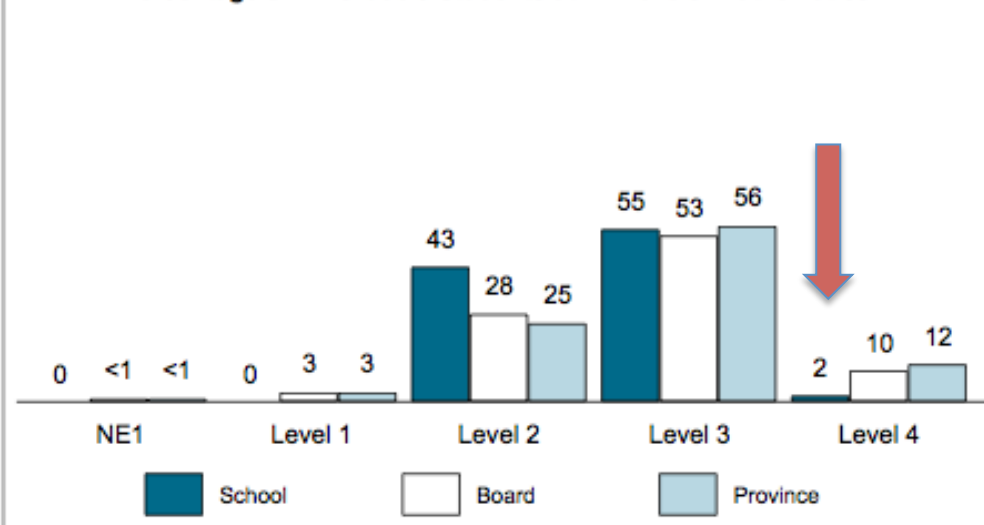
One School's Data Growth

Foundational Principle

Focus on mathematics.

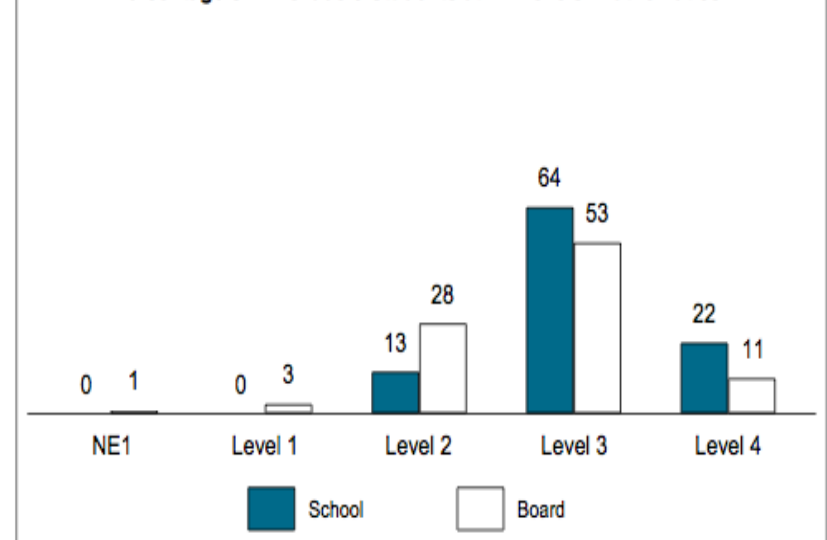
2008

Percentage of All Grade 3 Students at All Levels: Mathematics*



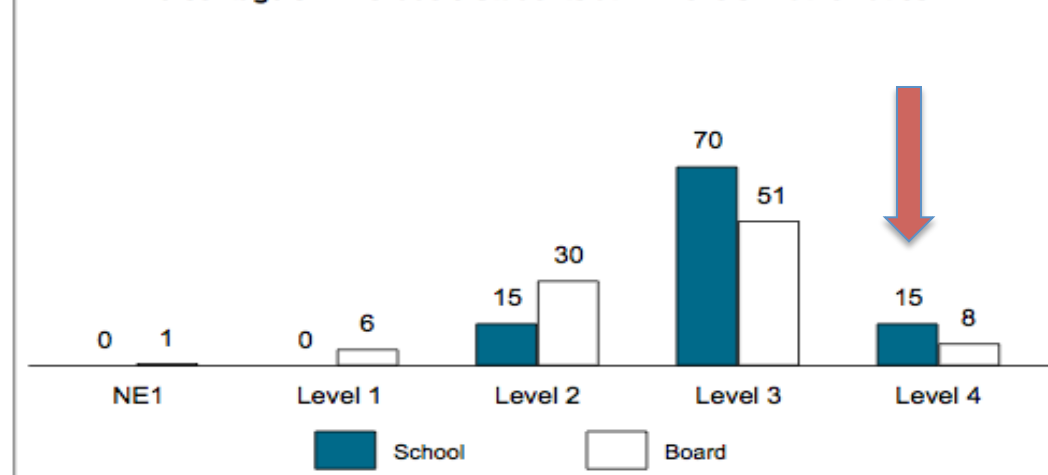
2010

Percentage of All Grade 3 Students at All Levels: Mathematics*



2011

Percentage of All Grade 3 Students at All Levels: Mathematics*



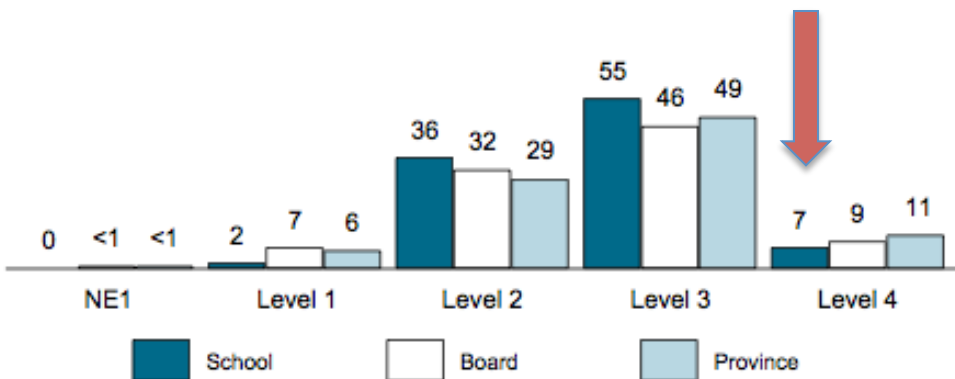
One School's Data Growth

Foundational Principle

Focus on mathematics.

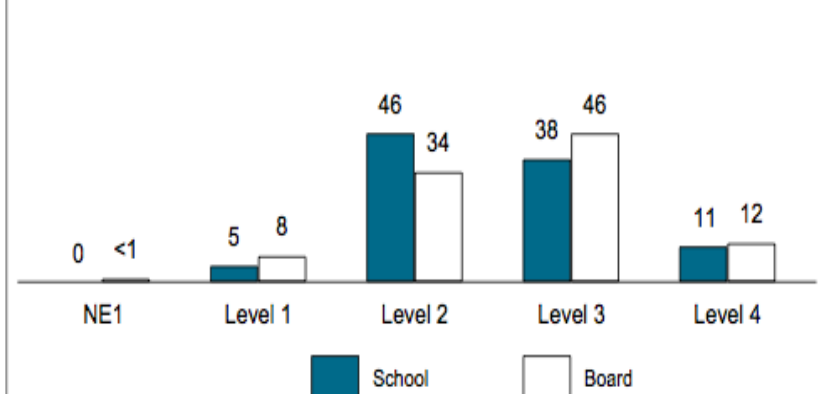
2008

Percentage of All Grade 6 Students at All Levels: Mathematics*



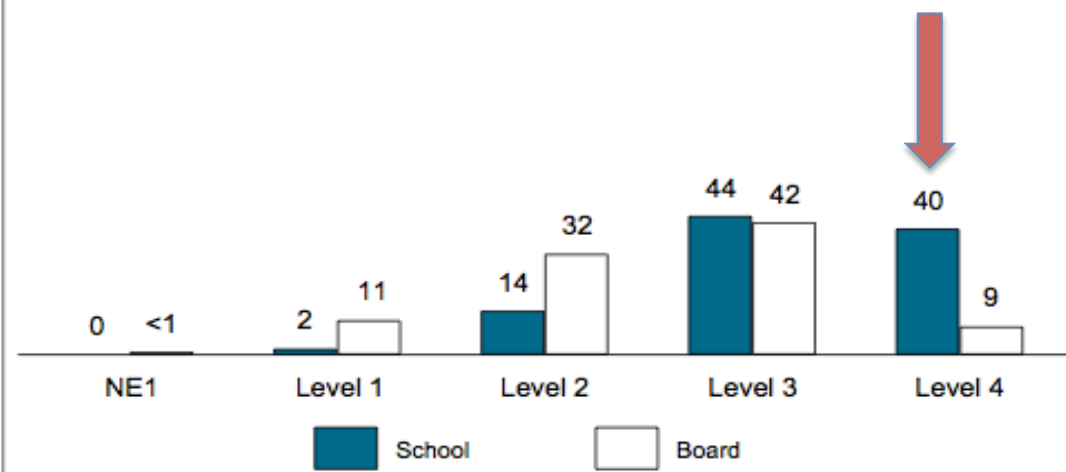
2010

Percentage of Participating Grade 6 Students at All Levels: Mathematics*

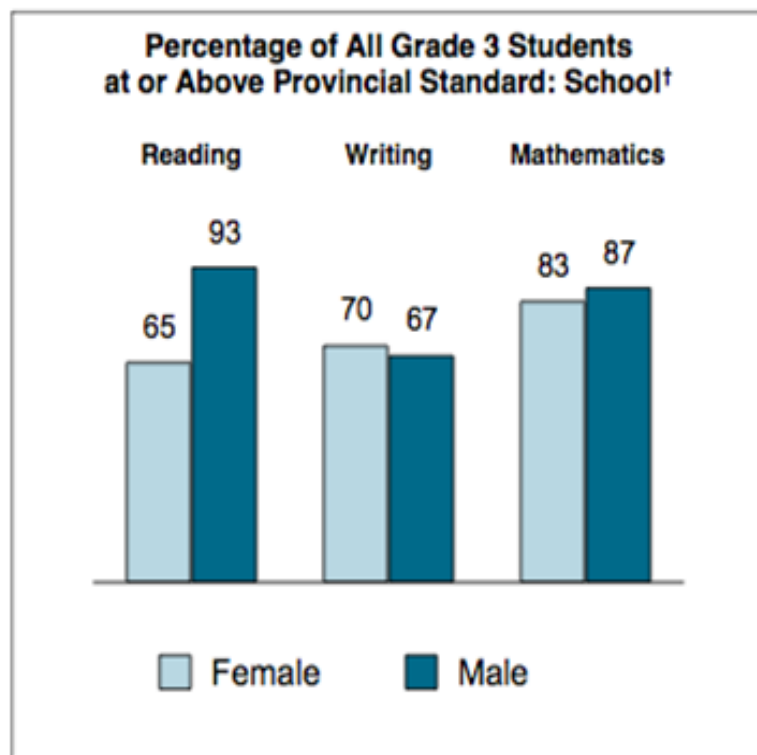


2011

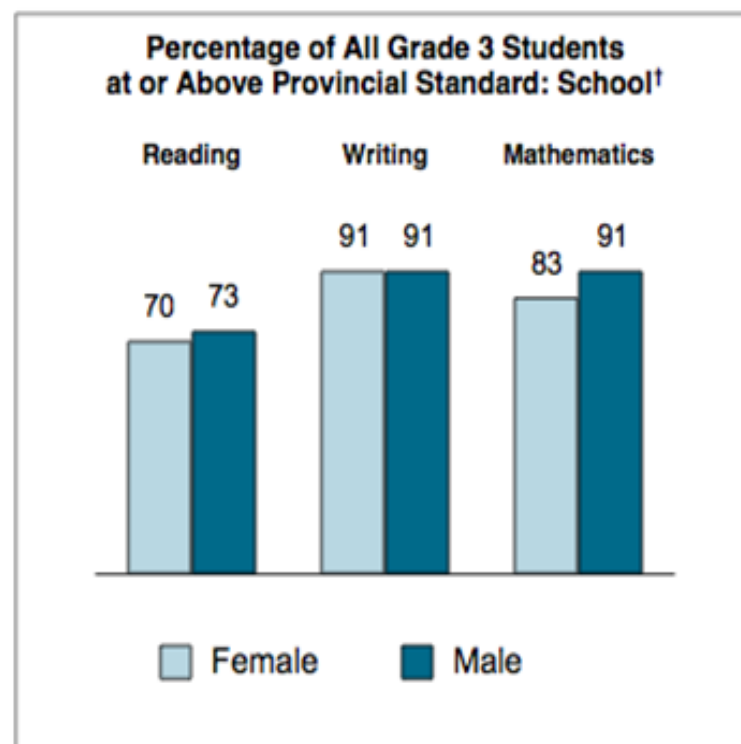
Percentage of All Grade 6 Students at All Levels: Mathematics*



Gender Data



2011



2010

Visit our Wiki!

- <http://plm2012.wikispaces.com/>

Thank You!

- Doug Duff: d.duff@tvdsb.on.ca
- Amy Lin: lina@hdsb.ca
- Demetra Saldaris:
demetra.saldaris@ontario.ca

Steven Katz - Collaboration



Gr. 5

Problem Posing

- Create three problems that seem really different that you would solve by subtracting one of these sets of numbers.

A. $80 - 14$

or

B. $5.2 - 1.48$

- Tell why each problem makes sense and solve each one in a different way.

problem ①

Brandon walked into a store with \$5.20 and he dropped some money. After he only had 3.72. How much money did he lose?

$$\begin{array}{r} \text{Answer: } 5.20 \\ - 3.72 \\ \hline 1.48 \end{array}$$

Brandon lost \$1.48.

Problem ②

Tyler ran 5.20 km and Hayden 1.48 km. How many more metres did Tyler run than Hayden

$$\begin{array}{r} \text{Answer: } 5.20 \\ - 1.48 \\ \hline 3.72 \text{ km} \end{array}$$

Tyler ran 3.72 more km than Hayden

problem ③ Brandon and Tyler had 5.20 mL of water altogether. Brandon has 3.72 mL of water, how much water did Tyler have.

$$\begin{array}{r} \text{Answer } 5.20 \\ - 3.72 \\ \hline 1.48 \text{ mL} \end{array}$$

Tyler has 1.48 mL of water.

Gr. 5

Problem Posing

- Create three problems that seem really different that you would solve by subtracting one of these sets of numbers.

A. $80 - 14$

or

B. $5.2 - 1.48$

- Tell why each problem makes sense and solve each one in a different way.

Madison is playing Socker there are 80 people on her team 14 people don't show up for practice, How many people are there?

$$\begin{array}{r} 80 \\ -14 \\ \hline 66 \end{array}$$

There are 66 players on the team today.

Madison read 80 pages of the hunger games and, Brooke read 14 pages of the hunger games. How many more pages did Madison read then Brooke?

$$\begin{array}{r} 80 \\ -14 \\ \hline 66 \end{array}$$

Madison read 66 more pages then brooke.

Madison had a set of 80 markers. Her friend Giselle borrowed some markers and left Madison with 14. How many ^{markers} did Giselle borrow?

$$80 - \quad = 14$$

$$\begin{array}{r} 80 \\ -14 \\ \hline 66 \end{array}$$

Giselle 66 markers.

This problem makes sence because you are subtracting the amount of players from the team.

This problem makes sence because you are figuring out how many more pages Madison read by subtracting Brookes pages and Madison's to get a difference.

This problem makes sence because you are figuring out how many markers Giselle borrowed by subtracting 80 and 14

Gr. 5

Problem Posing –
subtracting for the
“completely different
number”

Changed question to
 $80 - 66 = 14$ to make
sense of the situation
then recorrected.

Queen Elizabeth the 2nd
has 80 crumpets she
also banana cream pie.
she has 14 more crumpets
than pie.

How many banana
cream pies does she
have?

PLAN we will subtract
66 from 80

$$\begin{array}{r} 80 \\ - 14 \\ \hline ? \end{array}$$

SOLUTION

$$\begin{array}{r} 80 \\ - 14 \\ \hline 66 \end{array}$$

Queen Elizabeth has
66 banana cream pies!

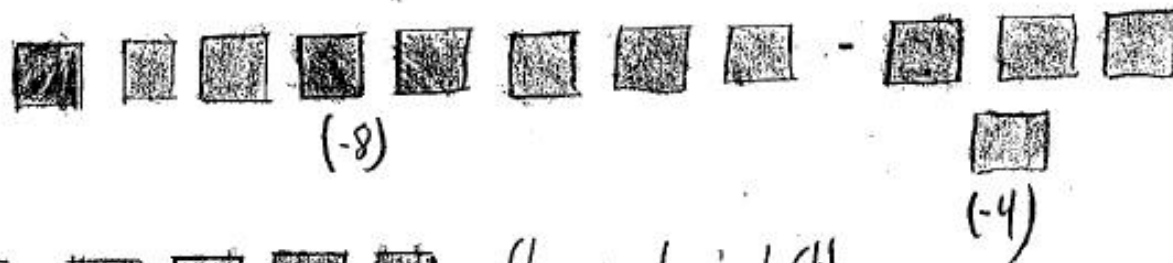
Gr. 7

Subtraction Situations

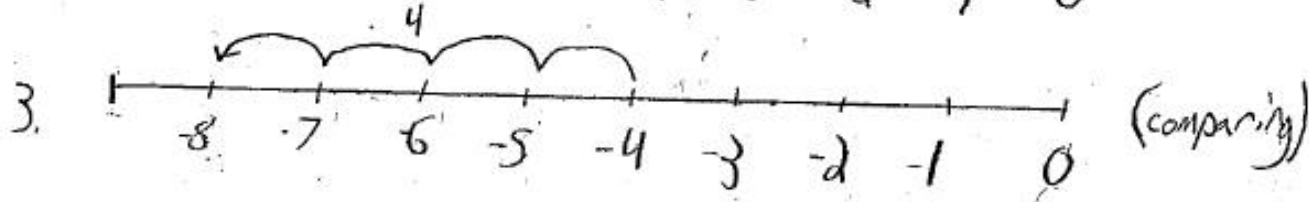
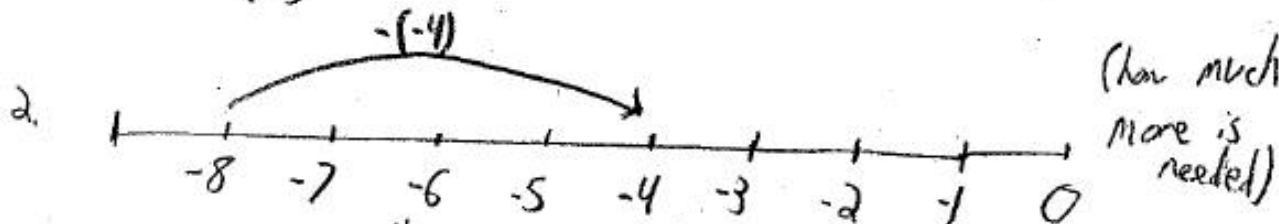
Show how you would solve this subtraction question in each of those ways:

A. $-8 - (-4)$

- blue/red blocks
- number line
- hot/cold



B. $\frac{2}{3} - \frac{1}{2}$



C. $5.2 - 1.48$

Reasonableness

If I have cold and I take away cold, it will be warmer. Since -4 is closer to 0 and it is a negative number it is greater than -8 .

Gr. 7

Subtraction Meanings Situations

①B. I can find equivalent fractions, that subtract, and put in simplest terms.

$$\frac{2}{3} = \frac{4}{6}$$

Diagram showing the conversion of $\frac{2}{3}$ to $\frac{4}{6}$. An arrow from 2 to 4 is labeled $\times 2$, and an arrow from 3 to 6 is labeled $\times 2$.

$$\frac{1}{2} = \frac{3}{6}$$

Diagram showing the conversion of $\frac{1}{2}$ to $\frac{3}{6}$. An arrow from 1 to 3 is labeled $\times 3$, and an arrow from 2 to 6 is labeled $\times 3$.

- I used 6 as the denominator. 2 and 3 go in to 6.

I can now subtract.

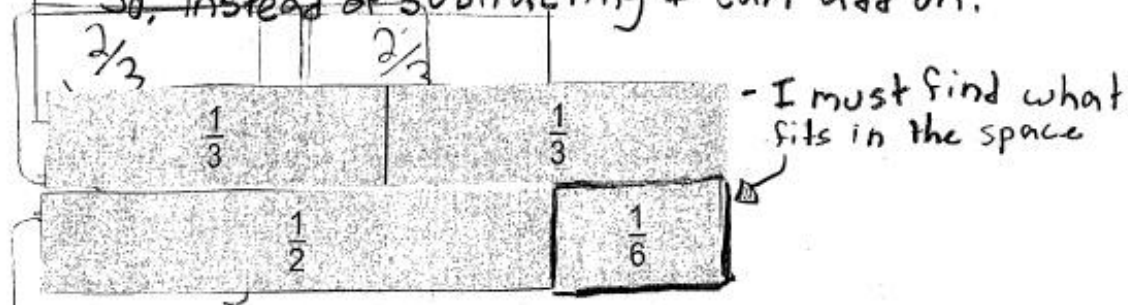
$$\frac{4}{6} - \frac{3}{6} = \frac{1}{6}$$

It is already in simplest form. There is $\frac{1}{6}$ left.

Subtraction Meanings Situations

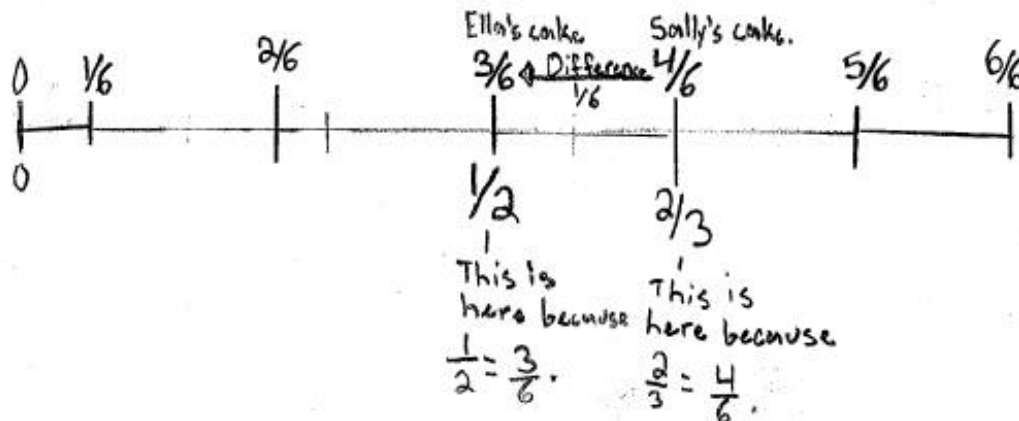
Gr. 7

2B. I can show this in a model with fraction strips. So, instead of subtracting I can add on.



∴ The builders need $\frac{1}{6}$ more of a piece.

3B. I can use a numberline. I can make the number line sixths because 6 is a common multiple of 2 and 3 (denominators).



∴ The difference in pieces is $\frac{1}{6}$.

Questions Made (1-3)

B.

$$\frac{2}{3} - \frac{1}{2}$$

- ① There were $\frac{2}{3}$ of pie left, then someone ate half how much is left? - 2B
- ② There is a piece of wood $\frac{1}{2}$ a piece long but the builders need a piece $\frac{2}{3}$ long. How much more wood is needed? - 2B
- ③ Sally has $\frac{2}{3}$ of a cake and Ella has $\frac{1}{2}$ a cake. What is the difference in pieces? - 3B?

Subtraction Situations

2. ● = positive
⊙ = negative

I want to reach a difference of 0 in this equation (have an even number of positives and negatives). To do this, I can either subtract the negatives or add positives.

 removed

There is 4 negatives left.

$$\circ\circ - 8 - (-4) = -4$$

3. Again, I want to reach a difference of 0 with this equation.



$$\circ\circ - 8 - (-4) = -4$$

We need to subtract -4 more to reach 0.

1. I am able to compare two negatives by determining which is less and by how much.

-8 ○○○○○○○○

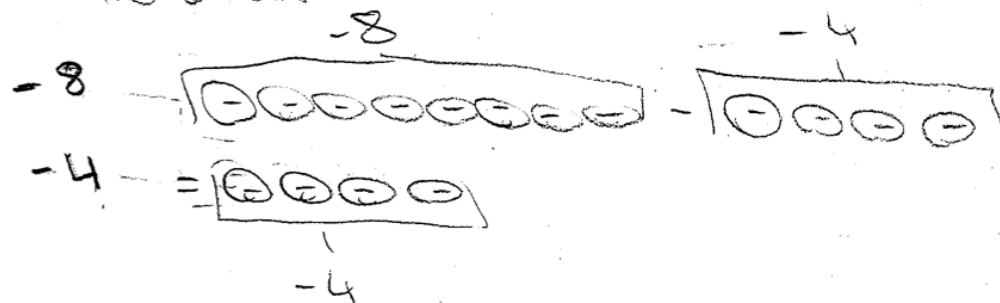
-4 ○○○○○○

-4 is greater because it is closest to 0. To reach -4, you must subtract -4 more. This is why -4 is greater than -8 by +4, and why $-8 - (-4) = -4$.

$$\circ\circ - 8 - (-4) = -4$$

Gr. 8

1) Compare how much more one amount is than the other:



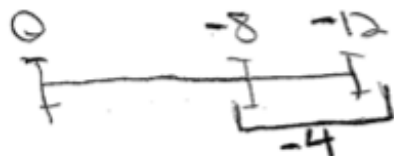
2) To tell how much is left:



After subtracting -4 we are left with -8

3) To tell how much more we need:

If my bank account balance is -8 and the max is -12 then I only have -4 to go until I reach the max.



Tim has $\$x$. He played poker and quadrupled his money, and tipped the dealer $\$2$. Then, he spent $\frac{3}{4}$ of his money on playing cards and got $\$2$ change. How much money does he have left?

The third question is similar to the first, with playing at the casino and tipping the dealer ($4x-2$), and the second part ($3x-2$) is represented by buying cards and receiving the change. Subtract these so you can get the money he has left.

$$\begin{aligned} & (4x-2)-(3x-2) \\ & = 4x-2-3x+2 \\ & = x \end{aligned}$$

1. Bobby wins a competition and has his money quadrupled, ending with \$400. He spends \$2 on a burger, but found out the burger had a dead fly on it, so he gets a refund of \$2. He then gets robbed, and loses three times the amount of money he had before he won the competition. How much money does he have left?

$$(4x - 2) - (3x - 2)$$

1.

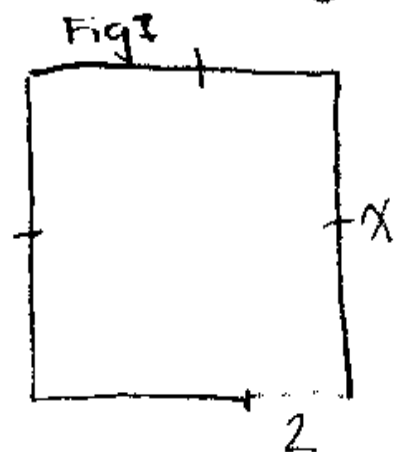
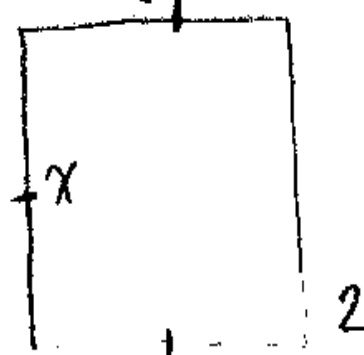


Fig 2



What is the difference in perimeter between these two shapes?

2. Jim and Max both sell oranges. Jim sells oranges for \$4, and Max sells them for \$3. Both sold the same amount of oranges, and both had to pay \$2 to rent out a booth. How much more money did Jim make than Max?

...then had 55

3. A ladder was set up against a wall, ^{with a cross on it.} A gust of wind pushed it over.

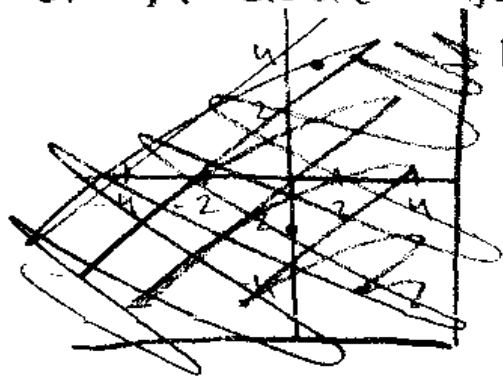
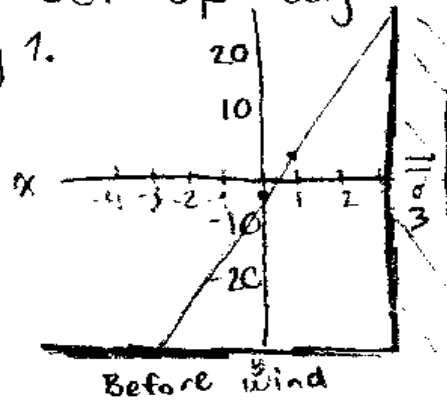
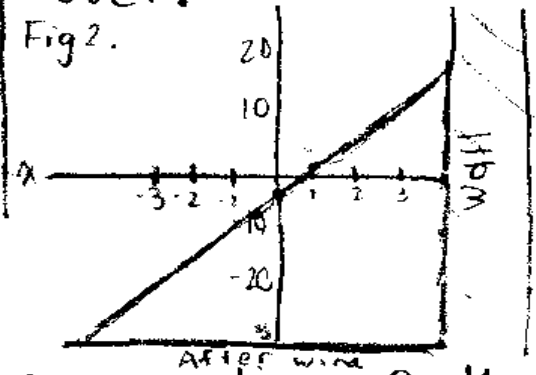


Fig 1.



over.

Fig 2.



Calculate the equation of the ladder against the cross, before and after the wind. Then, calculate the difference between the slope of the ladder before and after, and how much it slid downwards at the vertical line of the cross (the y-int.) For the second step, use only one equation.

how much more one amount is than another

$$\begin{array}{ccc} (4x-2) & - & (3x-2) \\ \uparrow & & \uparrow \\ \text{revenue} & & \text{cost} \end{array}$$

$$\begin{aligned} & (4(1)-2) - (3(1)-2) \\ & = (4-2) - (3-2) \\ & = (2) - (1) \\ & = 1 \end{aligned}$$

to manufacture one T-shirt is \$1

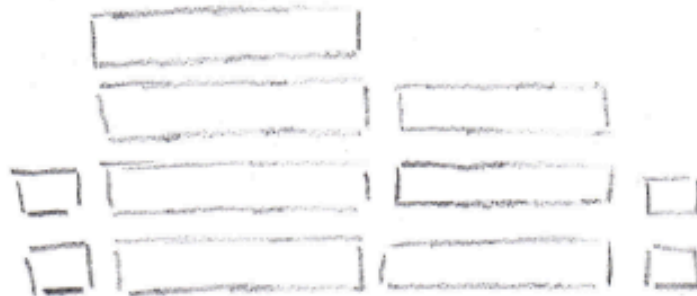
the revenue from selling one T-shirt is \$2

∴ they really only make \$1 if they sell one T-shirt because it costs \$1 to manufacture the T-shirt, and if they sell one T-shirt for \$2 they only make \$1.

how much is left?

$$(4x-2) - (3x-2) = x \quad \text{!!}$$

$\therefore x$ is left



$$(4x-2) - (3x-2)$$

$=$

